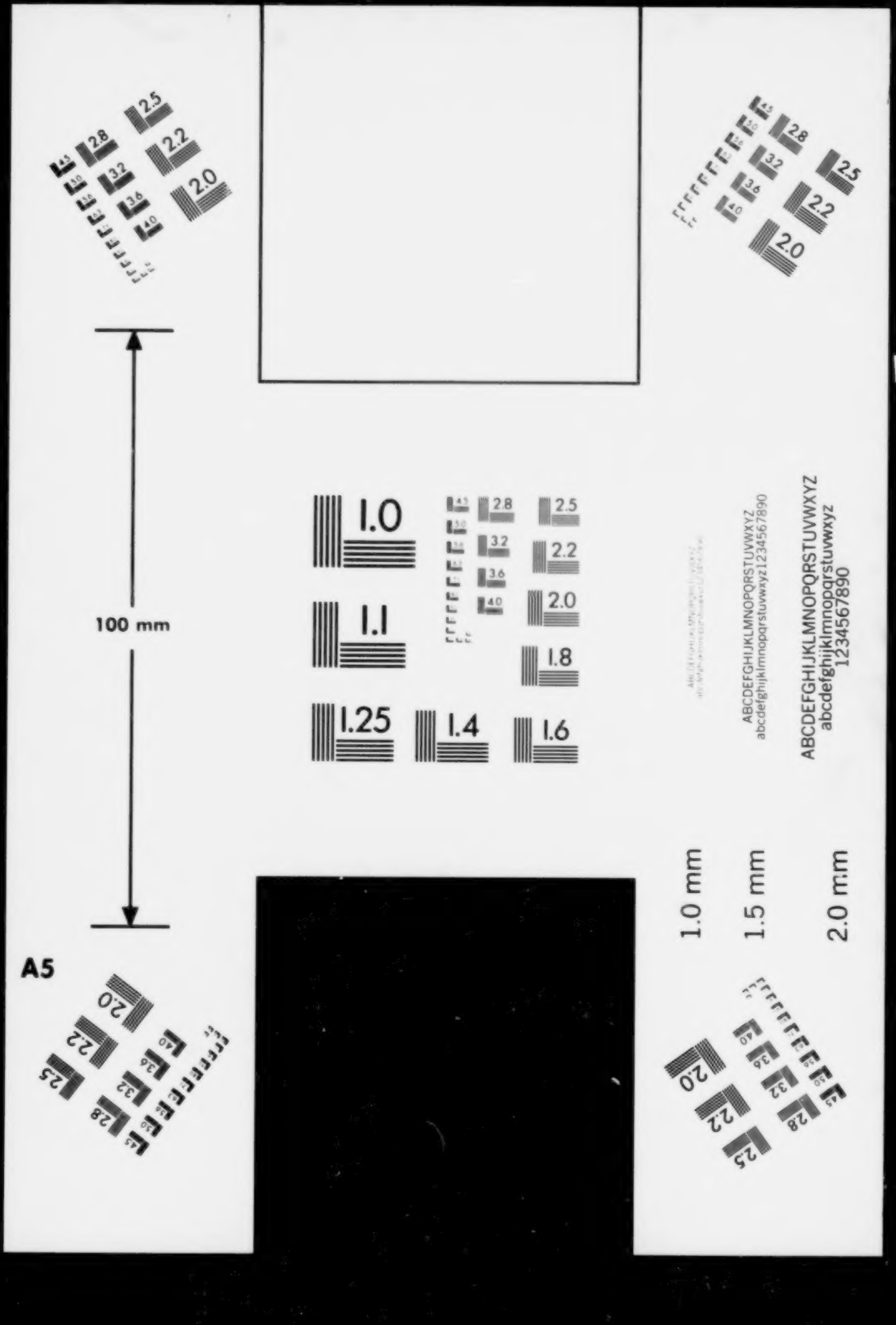
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ABSTRACT

This document contains four sections which deal with various aspects of international environmental education. Section 1 includes papers that describe environmental education projects and programs in South America, Europe, India, Scotland, the Arab states, and the Sudan. An additional article in this chapter compares the environmental education adoption potential of inservice workshop participants in both developed and developing countries. Section 2 contains papers on methods and perspectives on the evaluation of curriculum. It includes articles dealing with the evaluation of environmental education and curriculum materials, analyses of case studies of international environmental campaigns, a study of preconceptions of the biosphere held by children in several countries, and an examination of a new environmental awareness in science education. Section 3 includes two curricular proposals. One describes an action research approach to environmental problem solving, while the other proposes a method for teaching about international environmental issues at the university level. The final section of the document contains two papers on the environmental problems of international significance. One paper summarizes recent scientific findings on acid rain. The second proposes an educational strategy for addressing the problem of nuclear arms. (TW)

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MONOGRAPHS

In Environmental Education and Environmental Studies

Volume III

International Aspects of Environmental Education

SE 047 232

2

MONOGRAPHS

in

ENVIRONMENTAL EDUCATION

and

ENVIRONMENTAL STUDIES

INTERNATIONAL ASPECTS OF ENVIRONMENTAL EDUCATION

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NORTH AMERICAN ASSOCIATION FOR ENVIRONMENTAL EDUCATION

MISSION STATEMENT

The North American Association for Environmental Education (NAEE) is a professional association established to assist and support the work of individuals and group engaged in environmental education, research, and service. In meeting the goals and needs of environmental professionals, NAEE promotes the analysis and understanding of environmental issues and questions as the basis for effective education, problem-solving, policy-making, and management.

Through its activities, NAEE seeks to foster (1) the education of skilled individuals able to understand environmental problems and possessing the expertise to devise effective solutions to them, and (2) development of a citizenry conscious of the scope and complexity of current and emerging environmental problems and supportive of solutions and policies which are ecologically sound.

NAEE is organized into three interactive sections each conducting specialized programs responsive to their members. These are:

* The Elementary and Secondary Education Section (ESES)

* The Environmental Studies Section (ESS)

* The Non-Formal Section (NFS)

Professionals within these sections address the following audiences:

* the general citizenry;

* the fellow educators at all educational levels;

* those who make or facilitate the making of major decisions affecting the environment (e.g. government officials, scientists, engineers, planners, lawyers, journalists and mass communicators); and

* environmental resources managers (e.g. foresters, water resources managers, wildlife managers, park managers).

NAEE maintains the following guiding principles. Environmental Education should:

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- consider the environment in its **totality** - natural and built; biological and physical phenomena and their interrelations with social, economic, political, technological, cultural, historical, moral, and aesthetic **aspects**;

- **integrate knowledge** from the disciplines across the natural sciences, social sciences, and humanities.

- examine the scope and complexity of environmental problems and thus the need to develop **critical thinking** and **problem-solving** skills and the ability to synthesize data from many fields.

- develop **awareness and understanding of global problems, issues, and interdependence** - helping people to think globally and act locally;

- consider both short and long term **futures** on matters of local, national, regional and international importance.

- relate **environmental knowledge, problem-solving, values, and sensitivity at every level;**

- emphasize the role of **values, morality** and **ethics** in shaping attitudes and actions affecting the environment;

- stress the need for **active citizen participation** in solving environmental problems and preventing new ones;

- enable learners to play a role in **planning their learning experiences** and providing an opportunity for making decisions and accepting their consequences; and

- be a **life-long process** - should begin at a preschool level, continue throughout formal elementary, secondary, and post secondary levels, and utilize non-formal modes for all age and educational levels.

PREFACE

Future historians may look back on the twentieth century as the time in which people became conscious and occasionally thoughtful about the earth and the human species as a whole. To be sure, people in lands remote from each other have long been in contact, but before 1900 the role of those interactions to survival was generally not crucial. After 1900, the dependencies different peoples have on each other rose in importance, because mutual survival depended upon interactions. Moreover, mutual destruction became a physical possibility. Human society has not yet reached the point that all survival would cease if our global communications and commerce ended, but we have reached the point that warfare could destroy the abilities of all peoples in all parts of the earth to survive.

The global economy and the global warfare capacity are now all pervasive. The human species is by no means homogeneous, but most people are now conscious that events in far-away places can have an immediate and profound effect on their abilities to survive. What we are also coming increasingly to realize is that the global economy is absolutely dependent upon our abilities to protect the global environment. It is abundantly clear that we must preserve the cleanliness and integrity of the soil, air, water, and at least some species of plants and animal if we are to continue our existence. Environmental problems in one part of the globe, morever, are increasingly of importance to people who never see or even hear of the events.

Environmental and conservation education was, until the 1960s, primarily a local or regional affair. Efforts were conceived on the premise that if local folks managed their own local resources, then they would be all right. If folks far away didn't learn to take care of their own natural endowments, well that was too bad but not of importance to people in remote areas. Perhaps the discovery that pollutants (like radionuclides from nuclear weapons testing and pesticides) circulated globally stimulated environmental educators to realize that their efforts had to be comparable in scope to the threats posed by human activities in the Biosphere. Therefore environmental and conservation education had to assume a global character. People in different areas had to learn to collaborate on the design of new educational systems that could inform the world's citizens of the consequences of their actions and the possibilities for solutions.

The 1970s were marked by significant international efforts to increase awareness of the environmental conundrums facing humankind. Stockholm in 1972 and

Tiblisi in 1977 were just two of the more notable gatherings. All were dedicated to making the scope of the efforts in each local area match the challenges of environmental problems occurring on a global scale.

Papers collected in this volume are part of the ongoing efforts to build a global environmental education system. All contributions were given in at least a preliminary form at the 1984 Conference of the North American Association of Environmental Education held at Chateau Lake Louise in Alberta, Canada. Most participants were Canadian or U.S., but significant numbers of other scholars came from Australia, Europe, Asia, Latin American, and Africa.

Efforts to build a strong global environmental education movement necessarily must deal with a large number of complex topics. The papers included here are a mere sampling of the issues that need attention. I divided them into four major categories, each of which suggests a major area of study:

1. AREA STUDIES: Reports and analyses of what is being tried in different parts of the globe.

2. METHODS AND PERSPECTIVE FOR CURRICULUM EVALUATION: Educators must constantly evaluate the effectiveness of their efforts, yet evaluation of environmental education on a global scale is frought with many problems. Cultural values play a crucial role in determining whether or not a particular educational effort is appropriate and effective for a particular audience. It is unlikely that any evaluation methodology or perspective is globally valid, but the papers included in this section at least hint of the methodological questions that should concern scholars interested in global environmental education.

3. CURRICULAR PROPOSALS: This section by no means exhausts the need for new proposals for teaching at the kindergarten through higher education level. Nevertheless, the papers here are worthy of careful consideration by educators at all levels.

4. SPECIFIC PROBLEMS: Acid rain symbolizes the need for the new global environmental education system. It is a problem of air and water pollution that has destructive effects both near its source of origin and at sites remote from its generation. The particular paper here focuses on aspects of the problem in North America. Nuclear War is the ultimate environmental threat, because this form of warfare threatens to end all human life on

> earth. Perhaps other species would survive a massive exchange of weapons, but such events would be irrelevant to human history. Human history and consciouness of the environment would have ended.

Educators must continue the momentum of building a global environmental education network. Much work remains to be done, and the selection of papers included here barely scratches the surface. Topics most in need of development cannot be completely listed here, but the following are some of the most important:

1. What are the appropriate modifications of environmental education efforts to accomadate and integrate with different cultural values including religions, political and economic systems, and class differences?

2. What are the successes and failures of current environmental education efforts in areas not reported in this volume? No papers, for example, are included from Eastern Europe and the USSR. Europe, Africa, Asia, and Latin America are underrepresented in this volume. Finally, even countries with good representation, like the U.S. and Australia, are not completely described and analysed.

3. No institutional analyses are reported here. We need further work to understand the budgets and politics of international, national, and local organizations with environmental education responsibilities. The fate of UNESCO, an organization that has supported many efforts in environmental education, is not at all clear given the withdrawal of major donor countries such as the U.S. Scholars need to address the enormous number of institutional questions that affect the future health of environmental education.

Questions such as those listed above will require the dedicated efforts of environmental educators in the years to come. We have had some notable successes to date, some of which are documented in this volume. Whether we will ultimately be successful in contributing to the future health and safety of humans and other species on earth remains to be seen. At least we have begun.

John H. Perkins
Olympia, Washington, USA
July 12, 1986

ACKNOWLEDGEMENTS

All authors and editors quickly learn that they alone cannot make a book. Authors who contributed papers, only some of which were published, all deserve a large thanks for their efforts to build a global environmental education movement. Many anonymous reviewers gave generously of their time in helping with the selection process of the contributed papers.

Special thanks go to: David Alexis, Kathy Bauer, Paula Butchko, John Disinger, Diane Fisher, Joan Heidelberg, Sandy Higson, Joylan Netter, Judy Saxton, and Richard Wilke. Each of their contributions were different, but all of them played an essential role in making this volume possible.

SECTION I

AREA STUDIES

ENVIRONMENTAL EDUCATION ADOPTION POTENTIAL OF INSERVICE WORKSHOP PARTICIPANTS IN DEVELOPED VS. DEVELOPING COUNTRIES

by

Rosanne W. Fortner

ABSTRACT: Infusion of environmental education into formal school settings is an innovative process, and previous research in education has identified variables that facilitate adoption of innovation. A study was designed to compare the characteristics of teachers in inservice workshops in two different cultures with regard to their potential for adopting the innovations presented.

Teachers in two voluntary environmental education workshops in Ohio and two in Barbados were surveyed to determine their personal and professional characteristics and those of their teaching situations. The groups did not differ substantially between the two areas, except that Baradian teachers felt there would be less administrative support for their attempted innovations. Based on fourteen adoption factors considered, it is likely that teachers in the workshops in both areas are potential adopters of the innovative techniques and materials presented. Suggestions are made for maximizing the adoption potential of participants in other inservice training programs for environmental education.

Introduction

Formal environmental education programs frequently include teacher training as a mechanism for dissemination of environmental information, curriculum materials, teaching techniques and the like. Diverse evaluation strategies gauge the effectiveness of such programs in terms of their impact on the teachers themselves, their curricula, and their students. Rarely, however, are such programs evaluated for their potential among differing populations. Reviewing the literature of inservice education likewise does not provide such indications of potential, because reports usually do not include a complete characterization of the participants.

The literature of education contains many studies related to factors that facilitate the adoption of innovations. If it is assumed that the adoption of

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environmental education materials constitutes an innovation, the adoption literature can provide an important means of predicting the success of inservice environmental education programs.

This study was designed to incorporate the adoption literature with a comparison of teacher characteristics from inservice Environmental Education workshops in two different cultures.. The project assessed the potential for adoption of the environmental education materials and messages in developed versus developing countries, as exemplified by the United States (Ohio) and Barbados. Ohio is an industrialized state whose educational system overall is sophisticated in structure and varied in instructional formats. Barbados, by contrast, is much less developed industrially and educationally. Ohio and Barbados serve as examples of situations that exist in many areas of the world. Since the workshops conducted in these areas were very similar, differences in environmental education adoption potential in such areas can be inferred based on characteristics of the workshop participants and the cultures within which they function.

Accordingly, the study first considers the background literature related to adoption of educational innovations, the characteristics of the two representative cultures, and the workshop characteristics. Given these factors as a framework, a survey of workshop participant characteristics leads to an answer to the research question: What is the likelihood that the participants will adopt the workshop's environmental education materials and methods for use within their own cultural settings?

BACKGROUND

The education literature related to adoption of innovations is abundant. Research before 1977 has been summarized by Fullan and Pomfret (1977), who concluded that age, sex, education level and years in teaching are not dependable predictors of who will implement an innovation (p.385). The authors acknowledged that "not all teachers have the same propensity to implement," however, and more recent literature related to environmental science education has added some insights. The following lists characteristics of adopters, their school situations, and their inservice, opportunities that have been related to implementation of innovations:

A. Teacher Characteristics

1. Preparation in science and math (Dresser and Butzow, 1981). Marine infusion curricula introduced into Maine elementary schools would be most likely explored and/or accepted in schools with higher percentages of teachers having more academic preparation in mathematics and/or science.

2. Use of wide variety of teaching techniques (Lien, 1980). A positive relationship was found between a teacher's willingness to adopt innovations and the extent to which the teacher already uses a variety of classroom activities. No relationship was found between use of lectures and willingness to use innovations.

3. Positive attitude toward teaching (Lien, 1980). There is a positive relationship between the teacher's perception of the role of teaching and willingness to use innovations in education.

4. Positive perspective toward change (Lien, 1980; Evans, 1978). The teacher who has a positive perception of change is more likely to adopt innovations. Even recognizing the need for change facilitates adoption.

5. Professional activism (organizations, committees, conferences, etc.) (Evans, 1978; Lantz, 1984; Mayer and Fortner, 1985.) Change is facilitated by a staff who has traveled widely, taught in other school systems and attended numerous professional meetings.

6. Tolerance for turbulence (Evans, 1978). This is one of the personal qualities that facilitates change in education. It allows change agents to remain calm and avoid hasty decisions during periods of pressure that accompany change. This enables the adopter to work with other educators and administrators in a cooperative endeavor.

B. School Situations

1. Grades below high school (Fullan and Pomfret,1977). Various reasons are cited for the different success rates of adoption of innovations in elementary versus secondary schools. Some relate this difference to the finding that high school teachers are less willing to plan. Training backgrounds of the groups may bear on the differences, and perceptions of success of implementation also

relate to the differences. Finally, some research suggests that student attitudes toward change affect the implementation process, high school students being more cynical and apathetic. Change may not be rewarded by student responses under such conditions.

2. Administrative support for innovation (Evans, 1978). Changes being implemented by teachers are facilitated by active support of principals and general support of superintendents. Support for a change was found to be more important in adoption than was the initiator of the change.

3. Liberal communities; economically homogeneous clientele (Evans, 1978). The most likely place for change to be successful, according to reviews of research, is in liberal communities where parental income and education are high and whose members are ethnically, religiously and economically homogeneous.

4. Proximity to the subject matter (Dresser & Butzow, 1981). The likelihood of schools accepting marine infusion materials was significantly greater among schools within 50 miles of the marine environment. This had been forecasted by other studies that found marine instruction was more likely to be reported in coastal rather than inland schools.

C. Inservice Methods

1. Training plus ready-to-use materials (Solomon, et al., no date). Teachers who received maximum training (preservice, inservice and materials) scored 10% higher on degree of implementation than teachers who were given minimum training (materials only). Teachers in Cole's (1971) study ranked types of inservice training and preferred those that included demonstration lessons or model units.

2. Support and feedback as follow-up (Fullan & Pomfret, 1977; Lantz, 1984). Most studies reported in the literature lacked feedback mechanisms following inservice training, but Cole (1971) reported that feedback exchanges with consultants were a significant aspect of successful implementation. Continued contact between the implementers through periods of stress.

3. Participation in the innovation process (Evans, 1978; Lants, 1984). Active involvement in the process of developing new materi-

als appears to be a critical factor in degree of implementation of the materials. Individuals who have participated in change processes are more willing to participate in further change.

4. Monetary or other material incentives (Lantz, 1984). Lack of funding was identified by six groups of conference participants as the major barrier to implementation of an innovations.

Given this variety of factors, it should be possible within a given inservice effort to identify, or in some cases. construct, a number of situations that could lead to adoption of the workshop's intended innovations.

WORKSHOP DESCRIPTIONS

Four inservice environmental education workshops were conducted in 1983-84, two in Barbados and two in Ohio, U.S.A. (Figure 1). The workshops differed in funding source, presenting faculty and to some extent subject matter, but there were many similarities as well. All workshops included faculty from the Ohio State University, School of Natural Resources, Division of Environmental Education. All had as their goal an increase in environmental awareness among participants and the development of positive attitudes toward the environment, as well as encouragement to use non-text curriculum materials and open investigative methods for instruction.

More specifically, the subject matter of the workshop consisted of information on certain aspects of the environment, such as the characteristics of aquatic ecosystems and the economic importance of various natural resources. Information was presented on how these resources and ecosystems are influenced by human activities and what kinds of choices must be made to achieve a balance between economic gain and resource protection. The specific types of resources considered and the depth of the presentations were adjusted by the instructors based on the apparent level of background experience of the participants. For example, elementary school teachers in Ohio and social studies teachers in Barbados were provided with basic levels of

Figure 1. Workshop descriptions

Characteristic	Bds 1	Bds 2	US 1	US 2
Date of offering	4/83	4/84	3/84	6/84
Site	Barbados Community College	Barbados Community College	Findlay Ohio	Mentor, Ohio
Subject matter	Environmental Science	Social Studies	Aquatic Education	Aquatic Education
N of participants-	11	18	18	46
Sponsor	US Agency for International Development; Caribbean Conservation Association	US Agency for International Development; Caribbean Conservation Association	Ohio Sea Grant	Ohio Sea Grant
Presenters	Roth Mullins Disinger James	Roth Mullins Fortner James	Fortner Mayer	Fortner Mayer

science background in order to understand the concepts of resource management. Science teachers in both countries were found to have this level of preparation at the start of the workshops, so presentations and discussions proceeded in greater depth with these groups. Social studies teachers could discuss and interpret the economic implications of resource management with greater depth.

Instructors emphasized the role of teachers in providing information for wise decision-making about the environment and for fostering positive environmental attitudes. In each geographic area there was a focus on local environmental problems and potential solutions based on public awareness and involvement. The Ohio programs dealt mainly with Lake Erie, because of the sponsorship of Ohio Sea Grant. Those in Barbados considered soil loss, coral reef protection and solid waste disposal.

Teachers and workshop faculty also frequently discussed the realistic possibilities for implementation of the workshop information into classroom setting. Such discussions brought into focus some of the cultural differences, particularly regarding the use of "innovative" techniques such as board games and role-playing, and the professional and financial support for instructional programs in the schools.

The format of the workshops consisted of (1) introductory activities for acquainting participants and instructors and establishing a precedent for interaction; (2) alternate periods of subject matter presentations and hands-on activities; (3)' field work; (4) group projects and individual activities. For all portions of the workshop the instructors encouraged involvement of all participants. (Complete workshop descriptions are available from the author.)

Some workshop materials were prepared in advance for distribution to participants. These consisted of curriculum materials from the Ohio Sea Grant Education Program, Projects COAST (Coastal and Oceanic Awareness Studies) and ORCA (Ocean Related Curriculum Activities), subject matter outlines, and other activities developed by the instructors specifically for the local environment. All materials were designed to be infused into existing curricula, not added to the teaching load.

In addition, each participant was asked to produce an original or adapted curriculum activity as a final class project. This served as a means of applying information from the workshop and making an immediate transition of the methods into the classroom situation. The teacher-made materials were compiled and returned to all participants.

CULTURAL CHARACTERISTICS

General. Barbados, a developing country in the Eastern Caribbean, is a tropical island about twice the area of Washington, DC. Its population of about 256,000 (1981 estimate, U.S. Department of State) makes it one of the world's most densely populated countries. Eighty-percent of the population is black, 4% is white and 16% is mixed. The country is English-speaking and boasts a literacy rate of 99% in spite of only 9 years compulsory school attendance.

Politically Barbados has been an independent sovereign state in the British Commonwealth since 1966. Its form of government is a parliamentary democracy. Economically the island relies on tourism and sugar as its major industries, but it has a negative balance of trade. Per capita income is $3040. In the realm of environmental management, problems of solid waste disposal are mounting, and less land is being used for agriculture each year. The country was a pioneer in family planning.

The State of Ohio, representing a developed country, the United States, has a population of nearly 11 million, sixth among the states, with a population density of 262 per square mile. Seventy-five percent of the people live in urban areas and 10% are black. Schooling is compulsory between ages 6-18.

The greatest source of income (89%) in Ohio is manufacturing. Ohio leads all the states in production of rubber. Agricultural products, mainly soybeans, provide 7% of Ohio's annual production value. Average annual income in 1983 was $11,216. The state's natural resources include Lake Erie, large amounts of coal, salt and brine, and hardwood forests. The uses of all of these have led to controversies over environmental management: degradation of the water quality in Lake Erie, contribution of high sulfur coal to air pollution, effects of coal and salt extractions and timber harvesting on the landscape.

Education. School systems differ notably between Barbados and Ohio. Baradian schools take pride in assuring that a secondary education is available to all. Higher education is available through a community college, a polytechnic, a teacher training college and the University of the West Indies. There is a hierarchy of prestige among the secondary schools that extends to the teachers: only those who have graduated from the "best" schools are hired to teach there. Teacher salaries vary from school to school but there are generally high in comparison to the national average.

The Ministry of Education administers Baradian schools. The Ministry directs the curriculum and supplies instructional needs. Inservice training is frequently available on a variety of topics, and teachers avail themselves of such opportunities during their personal holidays.

From our experience, a typical classroom in Barbados is supplied with student desks in rows, a teacher's desk and a chalkboard. Learning is approached from a textbook orientation with few audio-visual aids and little hands-on learning. Environmental experiences for most consist of tree-plantings organized by the Ministry for special occasions such as World Environment Day. Regardless of this Baradian teachers are extremely well-informed on global political and economic matters. They are aware of environmental issues and curious about the opinions held by visitors on these topics.

Ohio is the home of the McGuffey Reader, a textbook used throughout the U.S. in the 1800s. It also has Oberlin College, the first coeducational institution of higher education in the country (1833), and 61 other accredited colleges and universities. All elementary and high schools in Ohio are supervised by the State Department of Education, but the schools have local control over curriculum content and sequencing, within Department guidelines.

Ohio schools are not wealthy. They are financed by a combination of state and local funds. During periods of economic recession. local funds may decline and schools may be required to borrow money from the state to remain in session. Ohio ranks 25th among the 50 states in per pupil expenditures.

Classroom instruction in Ohio takes varied forms, from field trips to laboratory experiments to role play to audiovisual presentation. Environmental education activities frequently involve outdoor experiences and may include school camping experiences. Variations are wide and are common in room set-up, level of student interaction, amount of individual assistance provided, and amount of reliance on textbooks. Teachers are committed to the teaching of certain concepts at certain grade levels, but there is considerable freedom for most in terms of how to approach those concepts.

WORKSHOP PARTICIPANT CHARACTERISTICS

Each participant of the four workshops completed a Teacher Questionnaire which requested demographic information, a description of the teaching situation, and an assessment of the school's facilities and potential for environmental education.

Demographic. The number of males and females did not differ significantly between workshops, nor did the age of participants, which ranged from 25-55. Of the

Barbados teachers, 60-70% had the equivalent of a Bachelor's degree. Thirty to 40% of the Ohio teachers held graduate degrees and 60% indicated they had taken three or more courses since completing their highest degree. Seventeen percent of Barbados teachers had this number of courses.

Job Descriptions. Ten percent of all participants were school or school system administrators. The grades taught by the classroom teachers ranged from kindergarten through twelve, with more elementary teachers in Mentor, Ohio, and other workshops having a wide range of grades represented. One-third of teachers in both countries reported teaching more than 100 students per day. The subjects taught varied in Barbados with the announced content of the workshop, namely science and social studies. In Ohio, 40-50% of participants taught all elementary subjects, and another 40% were science or social studies teachers.

Instruction Modes. For all groups, 75% taught using a required textbook. The mode of instruction most commonly used in all workshop groups was a total group instruction. Both groups (70-89%) regularly use classroom activities that are not included in their textbooks.

Support for Instruction. The school situations represented were quite varied. Half of the Ohio participants claimed that "a reasonable amount of money" would be available for new activities they might develop, but only 22% of the Barbados teachers expected such support. All Ohio participants indicated that their schools could provide for trips away from school, while 1/2 of the Barbados teachers would find this impossible. Many participants (36-50% U.S., 83% Barbados) found their schools' environmental education library holdings and other facilities to be less than adequate. Teachers in all groups expressed satisfaction with both teaching as a career and their own teaching situations, with up to 61% of the Ohio teachers claiming to very satisfied.

Environmental Education. The teachers' levels of participation in some types of environmental education activities are described in Table 1. More Baradian teachers than U.S. teachers indicated that they taught environmental topics and/or used the local environment for teaching "frequently" or "every day."

Inservice Needs. Participants were asked to indicate how important it would be to include certain topics in future environmental education workshops. Responses (Table 2) differed between the two cultures, with Barbadians expressing greater needs for assistance with development of materials and for strategies to evaluate both learner outcomes and teacher effectiveness. All groups indicated that teaching methods and

Table 1. Average percentage of teacher participation in EE activities in the twelve months preceding workshops

Activity	Not at all		Occasion-ally		Frequently		Every day	
	BD	US	BD	US	BD	US	BD	US
Visits to zoo or museum	61	23	39	67	0	10	0	0
Visits to the shore	28	45	44	43	28	8	0	3
Visits to historical sites	22	19	67	67	6	15	6	0
Viewing of environmental television programs	22	18	44	49	33	38	0	3
Attendance at environmental events	56	38	39	51	6	11	0	0
Use local environment for teaching	18	22	47	53	29	23	6	2
Use environmental topics in classroom teaching	11	6	33	50	50	38	6	5

Table 2. Teacher's average ratings of importance of topics for future E.E. workshops

Topic	Average Rating* Barbados	Average Rating* US
General background information in environmental subjects	4.56	3.87
Subject matter applications to local envir.	4.76	4.23
Subject matter applications to global envir.	4.22	3.75
Teaching methods for use of new activities	4.72	4.14
Work through new activities in workshops	3.76	4.24
Methods of evaluating student learning	4.50	3.73
Methods of evaluating teacher effectiveness	4.64	3.62
Review of available teaching materials on local topics	4.21	4.36
Review of available teaching materials on global topics	4.08	3.69
Audiovisual materials relating to envir. concerns	4.67	3.92
Assistance for developing teaching materials	4.72	4.14

*5 = Important; 1 = Unimportant

local applications of subject matter were of greatest importance. U.S. teachers in elementary schools considered it important to actually work through the available curriculum activities, while middle and high school teachers wanted assistance with curriculum development.

DISCUSSION

An assessment of the participants' potential for adoption of the environmental education materials and methods from the workshops can be made tentatively based on a comparison of the literature with teacher characteristics, summarized earlier. A number of the proven adopter traits were not assessed in this study, and some may indeed not apply to conditions in Barbados and other developing countries. Continuing education in environmental topics and professional involvement opportunities (characteristics A2 and A5 above) may be limited on the island because of the small number of teachers, and the traditional classroom setting appears to offer little turbulence (A6) because of its strong formal traditions. Some Barbados teachers verbally indicated that they had not received enthusiastic responses from administrations when they attempted to innovate (A2, A4 and B2). Among the U.S. teachers, on the other hand, discussions revealed the use of many techniques and varied materials.

Both groups did have very positive attitudes toward teaching (A3) and responded enthusiastically to the varied techniques demonstrated in the workshop activities (A2). In fact, more than 60% of all workshop participants produced active, hands-on materials on their own as the culminating project for their workshops.

School situations, especially administrative support (B2), may be limiting factors in Barbados' adoption of innovations. Community temperament (B3) was not formally assessed in the workshops, but experiences in the communities led to the conclusion that the Mentor, Ohio, workshop offered the greatest potential based on this situation. Mentor also had the largest percentage of elementary teachers (B1). While all workshops were organized with the help of school administrations, some Ohio administrators attended all sessions of their local workshops and even assisted with some of the instruction (B2).

Proximity to the subject matter (B4) was high in all workshops, as activities and materials were chosen with local environments in mind.

Inservice methods were relatively constant across all workshops. By design each workshop provided ready-to-use materials and training for their use (C1), and participation in the innovation process was assured by the development of activities following each workshop (C3). It is easier in the U.S. to provide follow-up support and feedback (C2), simply because of mail and telephone service differences, but attempts have been made to maximize this support for all workshops. U.S. teachers receive letters and additional materials to use in teaching. As for material incentives (C4), Barbados teachers who developed activities had them complied into a new manual for all participants of their workshops. The teachers thus gained recognition among their peers and in the Ministry of Education. Ohio teachers earned graduate credit during their workshops and became eligible for small grants to conduct other workshops.

CONCLUSION

Comparing Ohio and Barbados as examples of developed and developing areas of the world, it can be concluded that attention to the educational systems of either area can facilitate the adoption of environmental education innovations. The teachers who avail themselves of inservice opportunities do not differ substantially between the areas, at least within the volunteer populations served by this study. The fact that they are present in a workshop indicates that they recognize a need in themselves or for their schools to acquire the information and training. It may be that voluntary participants in inservice education are the innovation adopters of the teaching profession worldwide, and the job of providing that education is merely one of sustaining and perpetuating that desire for change.

Based on the factors discussed it is likely that teachers involved in the four workshops have a better than average potential to become adopters of the innovative techniques and materials presented. Many of the adoption facilitation factors were intentionally built into the total workshop program, and it is hoped that these factors will outweigh the potential problem areas. It will not be possible to have great impact on schooling style, but that is not the aim of environmental education programs. Rather the impact is targeted for individual teachers and administrators.

The more administrators that can be included in environmental education workshops the more likely that the materials and methods will be implemented, as in factor B2. Experience with these workshops has indicated that there are equivalent numbers of administrators who participate in both developed and developing countries, so opportunities for support of innovations should be equivalent.

Differences in levels of adoption may be dependent on school funding for some types of environmental education programs, thereby making adoption easier in wealthier countries. For the programs in this study, however, every attempt was made to provide for both cultures all the materials needed to implement the workshops topics. As for finding space in crowded curricula, a historic problem in the United States, teachers in developing countries feel the same types of pressure. The most commonly accepted method for getting environmental education concepts into curricula is infusion (Stapp, 1979), and Baradian teachers were receptive to this idea.

Because of the poor communication systems between the U.S. and Barbados, the workshop faculty do not have frequent follow-up contact with the participants there compared to the possibilities for continued involvement with the Ohio teachers (C2). There are also differences in sustainable contact based on the funding sources for the workshops: Ohio Sea Grant is a continuing program with increased funding each year. Follow-up and continued encouragement of workshop participants are a part of that program as in many other environmental education programs in the United States. Funding for the Barbados workshops and others in developing countries tends to be on shorter term bases. Needs are perceived to be so great in so many developing countries that funds are dispersed widely to get a greater geographic breadth, rather than concentrating on single areas and topic for depth of impact.

An important step in providing for "sustainable yield" from expenditures on programs in developing countries would be for the funding agencies to develop systems for monitoring specific progress from within those countries. Is the impact of a given program detectable and even incremental after one year, three years ago, and 58% have introduced those materials to other teachers (Mayer and Fortner, 1985). An equivalent return on the investment of an international development agency could have a great impact on its willingness to continue such efforts.

RECOMMENDATIONS

The Teacher Questionnaire (Appendix) should be modified to accommodate the cultures of other countries and to collect more information on community characteristics and professional activities of the teachers. This would facilitate prediction of workshop success.

In future workshops an effort should be made to involve school administration on a larger scale, especially in developing countries. These individuals can not only encourage innovation but also provide the follow-up support that may not be possible through overseas communications systems.

In order to extend the results of this research, some questions are offered as a basis for cooperative efforts with others working in environmental education for developing countries.

1. Are environmental education materials and methods presented through workshops in developing countries being implemented and incremented in schools in those countries over a long period of time?
2. What teacher characteristics facilitate adoption of education innovations in developing countries?
3. Can adopter characteristics be developed in teachers and school administrators, or can their acquisitions be facilitated by providing training and experience in innovation?

Educational change has historically moved at a glacial pace. Environmental educators should seek ways to speed innovations by combining the results of previous research and with what is known about the educational systems of different cultures.

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APPENDIX

THE OHIO STATE UNIVERSITY

TEACHER QUESTIONNAIRE

An important objective of our workshop evaluation program is to determine what types of experience and background help teachers use the workshop materials. We are therefore seeking information on your training, teaching situation and other factors that might relate to the teaching of the workshop topics. This questionnaire is designed to obtain that information. Please answer each each of the items carefully and accurately.

The information from this questionnaire will be used in making recommendations for the improvement of teacher training workshops and for comparing workshops in the United States and other countries.

DIRECTIONS

Please record all your responses on the teacher answer sheet using a #2 pencil. Turn the answer sheet so that "Side 1" is up. Fill in the following information in the left hand section of your sheet:

your sex
the grade(s) you teach
your birthdate

In column A under "Identification Number" indicate the subject that is your major teaching responsibility. Choose your answer from the following:

0. all subject (self-contained classroom)
1. science
2. social studies
3. mathematics
4. language
5. vocational skills
6. fine arts
7. physical education

Please answer the remaining questions in the right hand portion of the answer sheet.

(1) Approximately how old is the school where you teach?

1. 1-3 years
2. 4-10 years
3. 11-20 years
4. 21-30 years
5. 31 or more

(2) In how many different schools have you taught?

1. one (where you currently teach)
2. two
3. three
4. four
5. five or more

(3) What is your highest degree?

1. less than a Bachelor's degree
2. Bachelor's degree or equivalent
3. Master's degree or equivalent
4. Specialist (Post-Master's) or equivalent
5. Doctoral degree or equivalent

(4) When were you awarded your highest degree?

1. 1982-84
2. 1978-81
3. 1973-77
4. 1970-72
5. before 1970

(5) How many courses in your subject area have you taken since completing your most recent degree?

1. none
2. one or two
3. three to five
4. six to eight
5. nine or more

(6) How many different subjects are you teaching now?

1. one
2. two
3. three
4. four
5. five or more

(7) What is the average number of classes you teach each day?

1. one
2. two
3. three
4. four
5. five or more

(8) Which mode of instruction do you use MOST FREQUENTLY?

1. individualized instruction
2. small group instruction
3. total group instruction

(9) About how many students do you teach in an average day?

1. 30 or fewer
2. 31-50
3. 51-70
4. 71-100
5. more than 100

(10) Are you required to use a textbook for the main subject(s) you teach?

1. yes
2. no

(11) Would a reasonable amount of money from your school be available to a teach who wanted to try a new activity?

1. yes
2. no
3. don't know

(12) Does your school have a means of providing for class activities beyond the school (field trips, outdoor studies, and such)?

1. yes
2. no
3. don't know

(13) How often do you use activities from sources other than the student textbook?

1. not at all
2. occasionally
3. frequently
4. every day

(14) Do you think that students should be allowed to select topics to study in class?

1. never
2. sometimes
3. usually
4. always

(15) Do you feel that all teachers at a given grade level in you school should complete essentially the same materials by the year's end?

1. yes
2. no
3. There is only one teacher at any grade level

(16) Does your principal encourage your to develop your own instructional materials or sequences?

1. never
2. sometimes
3. usually
4. always

For the next 6 items, rate your school according to this scale:

1. less than adequate
2. adequate
3. above average

(17) The principal's support for science programs is:

(18) The principal's support for social studies programs is:

(19) The principal's support for language arts is:

(20) The principal's support for athletic programs is:

(21) The environmental education holdings of our school library are:

(22) Materials and facilities for environmental education are:

(23) Which describes your degree of satisfaction with teaching as a career?

1. very dissatisfied
2. dissatisfied
3. satisfied
4. very satisfied

(24) Which describes your degree of satisfaction with your teaching career?

1. very dissatisfied
2. dissatisfied
3. satisfied
4. very satisfied

(25) To what extent do you enjoy teaching environmentally related topics?

1. very much
2. somewhat
3. not at all
4. have not taught such topics

34

For the next 7 items, indicate the level of your participation in the last 12 months. Choose your responses from this list:

1. not at all
2. occasionally
3. frequently
4. every day

(26) Visits to the zoo or museum

(27) Visits to the shore

(28) Visits to historical sites

(29) Viewing of environmental television programs

(30) Attendance at environmental events

(31) To what extent do you use the local environment directly for teaching (in field trips, outdoors labs, etc.)?

(32) To what extent did you include environmental topics in your classroom teaching in this school year?

If other workshops are offered for inservice education in your area, how important would it be to include:

(33) General background information in environmental subjects

Unimportant 1 : 2 : 3 : 4 : 5 Important

(34) Subject matter applications to the local environment

Unimportant 1 : 2 : 3 : 4 : 5 Important

(35) Subject matter applications to the global environment

Unimportant 1 : 2 : 3 : 4 : 5 Important

(36) Training in teaching methods for use of new activities

Unimportant 1 : 2 : 3 : 4 : 5 Important

(37) Actually work through new activities in the workshop

Unimportant 1 : 2 : 3 : 4 : 5 Important

(38) Method of evaluating student learning

Unimportant 1 : 2 : 3 : 4 : 5 Important

(39) Methods of evaluating teacher effectiveness

Unimportant 1 : 2 : 3 : 4 : 5 Important

(40) Review of available teaching materials on local subjects

Unimportant 1 : 2 : 3 : 4 : 5 Important

(41) Review of available teaching materials on global topics

Unimportant 1 : 2 : 3 : 4 : 5 Important

(42) Review of audiovisual materials relating to environmental concerns

Unimportant 1 : 2 : 3 : 4 : 5 Important

(43) Assistance for developing curriculum materials

Unimportant 1 : 2 : 3 : 4 : 5 Important

If you have any specific suggestions for the content of such workshops, please write them on a separate sheet of paper and return them with your Answer Sheet.

THANK YOU FOR YOUR COOPERATION IN OUR WORKSHOP EVALUATION PROGRAMS.

ENVIRONMENTAL EDUCATION IN TRAINING OF HIGHER EDUCATION TEACHERS IN THE SUDAN

by

Professor M. D. El Khalifa

and

Dr. Yagoub A. Mohamed

The environmental training of qualified personnel was considered to be a priority activity by the Intergovernmental Conference on Environmental Education in Tbilisi, 1977. In its declaration, the Conference stated that....."There are still gaps and shortcomings. Less seems to have been achieved at secondary levels that at primary levels in schools, both quantitatively and in terms of innovation. Little has been done for training out-of-school educators or in-service teachers in environmental matters. There are still far too few trained for the teaching of ecology or capable of effective participation in a multidisciplinary approach. Last but most important, there still appears to be considerable need for developing or refining overall environmental education strategies in all forms and at all levels of education" (1).

This statement is true; the most important factor in the process of education, in general, is the presence of qualified tdachers to interprete the curricula, make use of the different facilities and, through their skills, disseminate information and knowledge to their students. Therefore, it is highly important that training programs for higher education teachers (H.E.T.) have clearly defined objectives and goals in order to:

1. Enable H.E.T. to seek and acquire knowledge in these fields and so gain a working knowledge of environmental science.

2. Acquaint H.E.T. with the educational methods and techniques required by a multidisciplinary approach.

3. Train H.E.T. to provide practical solutions to environmental problems and encourage responsible attitudes toward environmental matters among their students.

To achieve these standards the program must include basic instruction in environmental sciences, theoretical foundation and instructional skills. Specific work should be included so as to test competency in these areas (2). However, such competency should not be limited to the acquisition of natural scientific knowledge. It should extend to other disciplines with the aim of creating the ability to relate environmental problems to other issues (3). The multidisciplinary approach is then intended to strengthen the different means of promoting new environmental awareness and, with luck, new behaviour.

This awareness can be created only when competent H.E.T. tackle environmental matters with a holistic approach and transmit their environmental rationale to their students. The students should be provided with a clear awareness of the interdependence of economic, ecological and political decisions with environmental management. This goal is an indispensible element in undergraduate training of future professionals and policy-makers. In this respect, the concepts of environmental training and education overlap. Because the activities and decisions taken by future technicians, professionals and other specialisations will ultimately have an impact on the environment, their education should include basic knowledge, new skills and environmental awareness.

The introduction of this environmental dimension into existing university or college curricula requires a reorientation of the learning process. This reorientation starts with the university and college staff entrusted with executing these programs. Therefore, institutes of higher education must demand competency from their staff in the field of environmental education.

TARGET GROUPS

Before embarking on the description of the suggested training programs for H.E.T., we must identify our target groups. All universities and colleges of higher education possess their own teaching-staff development programs. H.E.T. are usually selected from among the best students, those showing excellence in their respective topics at graduation. A few of those selected receive postgraduate training to gain topical competency and then return to their respective departments and the duties of teaching and research. During their training, they may or may not be accidentally exposed to some environmental education. Although some topics, biology, geography, etc., inherently include environmental components, the majority of H.E.T. can be described as environmentally illiterate.

It is important to note that students will be either professionals who may develop into managers and policy-makers, or teachers of the tertiary level, who may in turn develop into teachers' educators, curricula developers, and education planners. Both groups will have a direct or indirect impact on the environment.

TRAINING PROGRAMS

Table 1 summarizes suggested H.E.T. training programs. Two training levels are considered: (a) pre-service training and (b) in-service training.

(a) Pre-service-Training

Although pre-service training of H.E.T. may start at the undergraduate level, more emphasis is put on the post-graduate level because, as mentioned previously, university and college staff are only selected after their graduation.

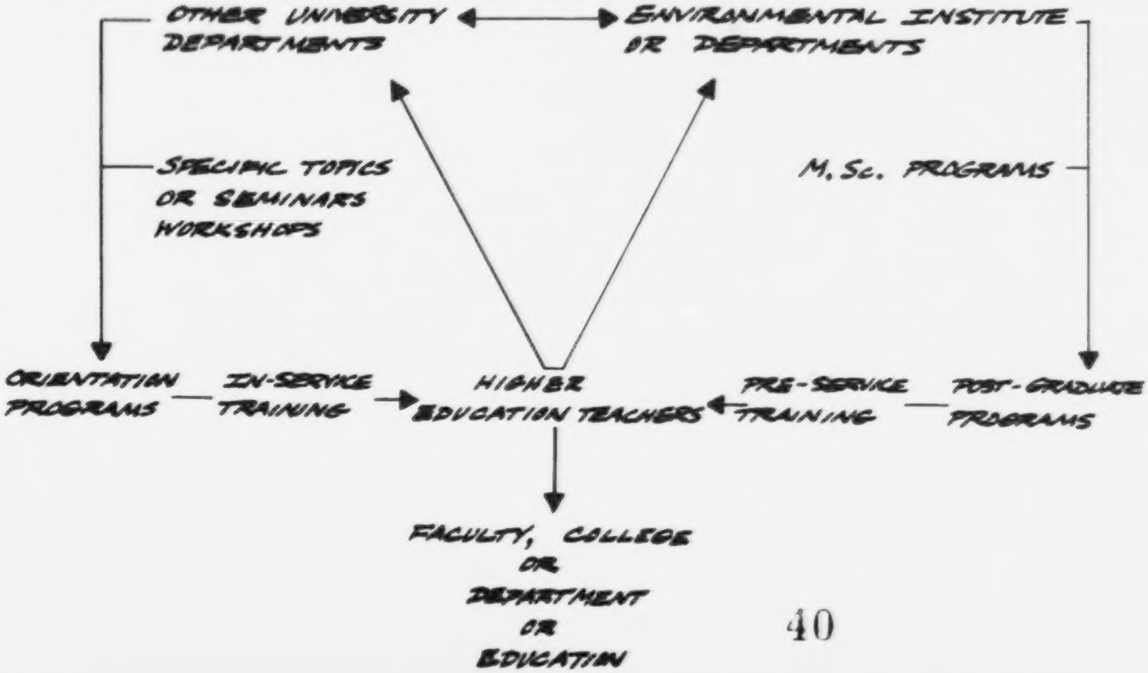
Lack of integrated environmental training exists in our universities. New perceptions and new awareness needed in environmental assessment and management must be promoted. This task could be achieved through well structured post graduate courses leading to further degrees. The courses should address specific student needs and the skills expected of them after training. The Institute of Environmental Studies (I.E.S.), University of Kartoum, may be of value to other African universities in this respect.

The objectives of I.E.S. are to provide the specialist, whether in natural or social science, with a new approach to awareness of and view of the interaction of man with his environment. The content of the M.Sc. course, therefore, derives from a variety of fields and disciplines (see Appendix I), taking into account the multi-disciplinary nature of environmental problems. All students attend the core courses while selecting optional courses according to their original specialization. A prepared thesis assesses their new skills and methods of environmental research.

In our opinion, such training at the M.Sc. level is necessary for future H.E.T. who later join university departments and colleges concerned with some aspects of the environment. Once H.E.T. have incorporated such environmental ethics in their knowledge, further postgraduate training (i.e. Ph.D. level) should be directed towards their speciality. It is anticipated that they will incorporate the newly acquired environmental skills in their further training.

Unfortunately, such comprehensive Masters programs may be unavailable in most African universities. Therefore, the need arises for the introduction of an environmental focus into post-graduate programs currently in a place at different university or college departments. Such intervention may be unacceptable with departments resisting the idea on the grounds of lack of time.

TABLE 1. ENVIRONMENTAL TRAINING OF HIGHER EDUCATION TEACHERS


OTHER UNIVERSITY DEPARTMENTS
ENVIRONMENTAL INSTITUTE OR DEPARTMENTS
SPECIFIC TOPICS OR SEMINARS WORKSHOPS
M. Sc. PROGRAMS
ORIENTATION PROGRAMS
IN-SERVICE TRAINING
HIGHER EDUCATION TEACHERS
PRE-SERVICE TRAINING
POST-GRADUATE PROGRAMS
FACULTY, COLLEGE OR DEPARTMENT OR EDUCATION

This argument can be overcome by offering optional courses which future H.E.T., in particular, are advised to attend.

(b) In-service Training

To carry out a pre-service training program requires the presence of qualified staff (trainers) able to train the trainees. Most of the trainers, although well trained in their respective speciality fields, are unfamiliar with the multidisciplinary nature of environmental education. To compensate for this lack, staff members involved in pre-service training programs have been exposed to specific topic-orientation courses, especially those dealing with environmental economics, environmental law and environmental statistics. Besides these orientation courses, they received training in systems analysis and computer programming.

The most arduous task is convincing H.E.T. engaged in teaching their topics of specialization of the need to inject an environmental dimension into their curricula. Professors generally resist attempts to make their courses more compatible with the multidisciplinary approaches and relevant to environmental issues. Our experience shows the most successful approach to in-service training for young H.E.T. is through workshops and seminars of one to two weeks' duration focusing on specific topics. A seminar which deals with the "environmental impact of development" was well attended by staff from Engineering, Economics and Agricultural facilities. Another, dealing with "water for human needs", was attended by staff from Engineering, Medicine, Geology and other departments involved in water provision.

Short seminars include preparation of workbooks which bring together reference materials taken from journals, books and other sources arranged according to topics to be discussed. This workbook is then kept by the participant for future use. Highly qualified staff also give lectures and lead discussions which are supplemented by case studies with participants using their theoretical knowledge to solve specific environmental problems.

For H.E.T. in the Faculty of Education, the I.E.S. organized a special seminar in 1983 with particular consideration given to the country's needs and problems. The program focuses on:

1) principles of environmental science;

2) the environment in Sudan, its problems and challenges;

3) environmental education, its place and purpose;

4) methodologies and curriculum development in environmental education;

5) planning of environmental education in Sudan;

6) field trips to nearby sites.

We hope this training program fulfills the objectives of increasing awareness and knowledge of environmental problems, acquainting H.E.T. with methodologies in environmental education and establishing strategies for the development of curricula in environmental education.

When the target group is represented by top level H.E.T. (e.g., Professors), workshops and conferences become more appealing as in-service training. Research findings on environmental problems are better disseminated in such workshops.

Publications provide another form of in-service training which serves the purpose of continuous environmental education. A newsletter (Sudan Environment), published by the I.E.S. deals with environmental or resource management problems and is received by all staff members. Furthermore, staff members are invited to contribute their research findings to be published in the form of discussion papers.

RESEARCH AND TRAINING

The regional meeting of Experts on Environmental Education in Europe, 1977, emphasized the links between training and research at the university level. All teaching must be based on current research in order to remain topical. This rule applies to environmental education as well, even if environmental research is less developed in some countries and universities (4).

One of the main objectives of I.E.S. is to encourage and promote multidisciplinary research projects with teams working either independently or with other university departments or government agencies. Sudan faces a number of environmental problems shared with other African countries: desertification, rapid urban growth, disturbance of coastal zones and disruptions arising from large scale water projects. The I.E.S. has selected four major areas of national and regional significance for research:

1. Fresh water ecosystem management
2. Coastal zone management
3. Arid land management
4. Urban and regional management.

From these broad research areas, specific projects have been developed to study Sudd ecology, water resources management, environmental change in arid areas and problems of human settlement in the capital city. Research findings are often reflected in the M.Sc. teaching programs and disseminated through publication in the Institute's Monograph Series. The research findings are also presented in workshops that bring together researchers, planners and decision-makers. Workshops such as "Desertification Control", held in October 1982, attracted large audiences, including H.E.T..

REGIONAL COOPERATION

One of the main objectives of the I.E.S. is..."to encourage, coordinate and disseminate information about research, teaching and training in environmental studies, especially at the national and regional level" (5). The Sudan is Africa's largest country. It shares many environmental problems with other parts of the continent. The I.E.S., the first of its kind in Africa, is ideally placed to serve not only the needs of the Sudan but also those of neighboring countries. The M.Sc. program is well suited to train professionals and H.E.T. in developing the skills necessary for environmental assessment and management. Short orientation courses suitable for in-service training could be designed to serve the needs of the region in training H.E.T..

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APPENDIX I

M.Sc. in Environmental Studies: Core Courses and Options

First Year

CORE COURSES

First Semester:

1. Principles of environmental science
2. Applied climatology and geomorphology
3. Cartography and remote sensing
4. Community health and demography
5. Environmental economics
6. Basic statistics for environmental research
7. One optional course.

Second Semester

1. Environmental assessment, management and planning
2. Environmental and resource law
3. Rural development
4. Applied ecology
5. Production technology, engineering and the environment
6. Methods of environmental research and assessment (including environmental case studies)
7. One optional course.

RESEARCH RELATED OPTIONAL COURSES

A. Fresh water ecosystem management

    1. Fresh water ecology
    2. Water resources management
    3. Soil and water conservation

    4. Range and wildlife management.

B. Arid land management

    1. Marginal land use
    2. Environmental forestry
    3. Soil and water conservation
    4. Range and wildlife management

C. Coastal zone management

    1. Oceanography and marine ecosystem
    2. Water resources management
    3. Minerals and energy resource management
    4. Industrial and urban water use and quality control.

D. Urban and Regional Management

    1. Pollution and environmental health
    2. Urban planning and the environment
    3. Minerals and energy resource management
    4. Industrial and urban water use and quality control.

Second Year:

Third and fourth semesters are devoted to students' research projects and presentation of a typed thesis.

ECOLOGICAL CULTURE AND QUALITY OF LIFE

by

Hernán Contreras Manfredi

(Nancy Allen, Translator)

ABSTRACT: This article describes the characteristics of the program PIDCEC, an initiative of the author, which has served as intensive training for "Cultural Instructors" in the development of an ecological and conservationist culture. With very precarious means of support the program has served 2500 participants since its founding in 1982. It has been active in 45 cities in Venezuela and 6 cities in other countries -- Chile, Argentina, Paraguay, Uruguay, and Panama. It is now beginning a second more complete phase which intends to offer over the next 6 years a total of 100 workshops-courses of 3 days apiece and 100 seminars of 100 hours apiece in Venezuela, and 50 workshops-courses and seminars to share the experience with other Latin American countries (Chile, Argentina, Uruguay, Paraguay, Brazil, Ecuador, Panama, Bolivia, Dominican Republic, Guatemala, and Honduras).

The program uses the analysis of ecological principles as support for conservationist criteria, and these in turn as support for development. By development we mean exclusively improvement in the quality of life, based on 5 factors of human dependence. These factors are the following:

A. Factor of physiological impact.
B. Factor of psycho-physiological impact.
C. Factor of cultural development toward the participation of the individual in the community.
D. Factor of social conditioning.
E. Factor of ecological dependence.

A modest program

With the name of Training Program in the Development of an Ecological and Conservationist Culture, (PIDCEC), under the auspices of the Ministry of Health and Welfare and the Central University of Venezuela, and with the collaboration of other educational and cultural institutions, the author of this article is carrying on an education program which intends to stimulate the development and/or enrichment of an ecological and conservationist culture in the Venezuelan community, an action imperative in almost all Latin-American communities, with which the Program is also sharing some experience. UNESCO's Office of Science & Technology lends it institutional support to this program.

Purposes

Desiring to emphasize the close relationship between ecological culture and quality life, this activity has as its fundamental purpose to train cultural instructors: to provide them with support materials and methodological direction which will allow them to diffuse the contents of the program, multiplying its effects. The PIDCEC program takes advantage of the background of the participants who are, in order of their numerical importance in the makeup of the groups, 60% educators, 20% professionals such as biologists, agricultural and forest engineers, geologists, geographers, veterinarians, and lawyers; and 20% university students.

The general purposes are to provide brief and intensive training in cultural aspects of ecology and the conservation of natural resources. More specifically, to show the participants the possibility of a conceptual analysis of ecological principles, criteria for conservation of natural resources, and different styles of development; all the foregoing in relation to the quality of human life.

The Program proposes to make a modest contribution to the development of attitudes and behaviors appropriate to the adequate use of the environment and natural resources. The modest nature of the program means that many actions similar to or better than this one are necessary. This program desires to stimulate others, simultaneously demonstrating that with very modest resources, significant results can be achieved. The Program is self-generating and receives economic support from no national or international institution, but it does receive logistical support expressed in the coordination of activities and the use of auditorium space, etc., from institutions in the cities where it operates.

This activity was begun in mid-1982 in prospective form, and now (October, 1985) the plan is beginning to run in its complete form for 5 academic years (1985-86 to 1990-91). The last academic year will complete the seminars begun in 1989-90.

Structure of the Program

This activity consists of two levels--a 3-day Course-Workshop (18 hours) including lecture, discussion and analysis of cases, application of criteria and concepts, and familiarization with educational materiais designed for children, adolescents, and the community. The methodology combines exposition, including graphic and audiovisual support, and demonstration/discussion.

The second level is a seminar based on the capacity for initiative, self-discipline and responsibility of each participant. Students are required to do 90 hours of work, which are evaluated at the closing session of the seminar, after one year.

Course-Workshop: (Content)

I. Course: Ecology - Conservation - Development - Quality of Life (6 hours)

Themes: Ecological Culture. Quality of Life.
Conservation, Development and Survival.
A model for evaluating quality of life.

II. Workshop: Evaluating the Quality of Life (6 hours)

Themes: Analysis of cases; application of model demonstrated.

III. Course: Evaluation and Adequate Use of the Environment and Natural Resources. The Ecosphere and Natural Resources and Characteristics of the Environment. Criteria for Appropriate Use of the Environment and Natural Resources. Analysis of cases. Slides and two 200-page textbooks are used as aids, and given to the participants as part of the two courses.

Seminar: Content

I. Opening Session (5 hours)

Presentation of activities and time for getting to know one another.

II. Substantive Activities (90 hours)

a. Assigned readings and observation derived from them (12)

b. Lectures the participant is required to give (2)

c. Small individual project (write a story; correct one feature of erosion; apply alternative technology; evaluate quality of life; solve a small pollution problem, etc.)

III. Closing Session (5 hours)

a. 10 minutes per participant to report on projects

b. 20 minutes per participant to give a lecture on a pre-determined topic

At the end of the course-workshop, participants receive a certificate of attendance granted by the Ministry of Health and Social Assistance and UNESCO. When their work for the seminar is approved, they receive a statement from the Central University of Venezuela.

Results to the present

Between 1982 and the present, the course-workshop alone has been presented to 2500 people, from 45 Venezuelan cities and 6 cities in other South American countries. By 1991 the whole program will have been presented 100 times in Venezuela and perhaps 30 times in other countries.

The most essential thing has been achieved: deep motivation of the participants, who have acquired a capacity for analysis and observation of situations which previously did not concern them or which they did not understand.

Now, at the beginning of the seminars, which will be offered for the first time to graduates of the course-workshop, we have the certainty of being able to push them into action, as individuals, through education, or by supporting already-established ecology and conservation groups.

Projection

Outside Venezuela, parallel courses are being offered in Corrientes (Argentina); in Asuncion (Paraguay), under the auspices of Pronatura and the National University of Asuncion; in Santiago (Chile), with the support of the Committee to Defend Flora and Fauna, the College of Architects and the University of Talca; in Panama, under the auspices of the National Bank of Panama. The program is being solicited by Brazil, Bolivia, Ecuador, Guatemala, Honduras and the Dominican Republic.

The proposed goal for each Latin American country is to repeat the series until 200 people have been involved, with the objective of stimulating similar activities, which would grow out of the depth of motivation and training that is achieved each day.

Seven months out of the year are dedicated to the program full-time, with the half-time collaboration of Licenciada America Cordero Velasquez.

A program of this type is only a very small action in relation to the needs of Latin American culture; nevertheless its significance could be to provide stimulus and a proven model so that institutions in other countries might be able to begin activities with greater impact. Suffice it to say that the PIDCEC program is operated out of an office 12 meters square and possesses one car, one slide projector, one camera, and one typewriter.

Obviously, there is a direct, linear connection between Ecology, Conservation, Development and Quality of Life. It would not be logical to think about adequate criteria for the conservation of renewable resources if they were not sustained by the essential and fundamental principles of ecology. Neither would it seem logical to pretend to stimulate development if this, as a global concept, were not sustained by adequate criteria for the conservation of natural resources, the only guarantee of a stable, sustained process towards durable goals. The global concept of development is very questionable if it is not reflected in its one conceptual synonym -- the improvement of the quality of life for a whole community. It is possible to find many examples of economic, industrial, agrarian or any other kind of development, but if these bring about deterioration in the quality of life or do not improve it, they will be simply developmentalist conceptions, many times mere monetary expressions, and frequently demagogical expressions which frustrate the legitimate intentions of the poor countries of the world.

Principles of Ecology (going back to the ideas of Haeckel)

Considering the fundamental bases of ecology and without going into concrete examples of the analysis of ecosystems, we can distinguish three principles, already implicit in the origins of this scientific discipline, that is to say put forward more than 120 years ago, which during such a long period of time and along with undeniable scientific development, have not been enthroned in cultural praxis and are in general terms, only relevant theoretical principles. These are the principles of human action in ecosystems -- economy of energy, of nutrients, and of biological capital.

When we speak of economy of energy in the treatment of ecosystems, we refer basically to the preservation of the capacity to capture energy through the process of photosynthesis, point of departure of biological activity, of trophic chains, of the regulation of other energies of the physical environment, etc. The conduct of men in this area has brought about and continues to bring about gigantic devastation of the forest masses of the world, a fact which is evident, tangible and overwhelming in the majority of Latin American countries, such as Paraguay, Brazil, Venezuela and others.

When we refer to the economy of nutrients, we mean the need to preserve the productivity of the soil resource, avoiding erosion of fertile lands, avoiding the subtractive uses of fertility, among others deterioration through chemical instability or through abuse of monoculture. The value of eroded land surface in Latin America can only be expressed in millions of hectares, in the Andean Bad-Land of Venezuela, the Chilean coastal mountain range, the severe erosion of the state of Parana in Brazil, the destruction of soil in the province of Malleco in Chile, or the immense magnitude of soils buried in sand, product of aeolian action and disequilibrium of the litoral plains of Peru and many sections of the Argentine Pampa, a sketch to which can be added average losses that fluctuate between 60 and 100 tons per hectare per year in the hilly areas of Mexico, Central South America, in all the areas dedicated to agriculture in the lands we have mentioned.

With reference to the economy of biological capital, we assert the ethical and practical necessity of preserving flora and fauna as components belonging to nature, as biological potential, directly or indirectly useful to man; in the face of this, the very devastation of the forest we have mentioned means the loss, many times irrecoverable, of thousands of species and others which have been reduced to easy vulnerability or which can be shown to the present work as curiosities. The tendency to monoculture, the planned lack of reserves and protected zones of genetic capital, the indiscriminate advance of agriculture, shows us that the forest which once (40 years ago) occupied several million hectares of the Alta Parana in Brazil is represented by an "authentic display" of 70 hectares or that, in the Department of Caazapa in Paraguay the forest of the warm humid geographical region will be represented by an illusory example, the protected forest of Caaguazu, which is nothing else but the only non-commercially profitable section of that region, and consequently, a demonstration which, if it is not made larger, will be a vulnerable and imperfect example of the original biological capital; examples of this kind are very frequent in Latin America.

Criteria for the Conservation of Natural Renewable Resources

Given man's many irrationalities, speaking of rational use does not capture the real intended significance of the term. For that reason we have chosen to refer simply to the good use of natural renewable resources, which is directly oriented toward achieving and maintaining an adequate balance between population and resources, a situation that cannot be stable if the productivity of ecosystems is not maintained and preserved. This conception, so simplified, represents the criteria which should mark activities designed to conserve renewable national resources for the benefit of man and his quality of life. Considering in this case a utilitarian criterion for man, in the face of necessity imposed by accelerated population growth.

Good Use of Resources

This implies acting in conformity with the basic elements of ecological culture, whose directions will be defined later. Good use also implies an ethical criterion or scheme respecting not only utilitarian interests, necessary in some cases, but also the necessity of preserving specific environments, respect for other species' right to exist, the right to life of diverse human groups, however modest their cultural structure might seem, and, logically, respecting the integral functioning of ecosystems and nature itself, insofar as human survival depends directly on it, without this conception leading us to exclusively anthropocentric thought.

As a case of the good use of natural resources, and centering ourselves in Venezuela (there are also excellent examples in Brazil and other Latin American countries, going back in history), we will take the natives of the Amazon Federal Territory, the Guajibos, who represent an unquestionable potential for agricultural production, if it is not weakened at the base. They apply specific criteria to the use of poor tropical soils, whose fertility is easy to destroy; in these conditions, the Guajibos burn small sections of forest, of approximately one hectare, grow crops there for two or three years, and then change place. This, in this specific case of soil with a slight slope, sandy, with little organic material, permits them to produce according to their needs, take advantage of the cations in the ash, preserve the continuity of the habitat for animals which give them protein, avoid water runoff and erosion, and permit the regeneration of the forest. The mathematical maximization of these principles would permit a definition of the maximum limits of use of this medium. If on the other hand, massive deforestation and mechanization were to be applied there, a "technicized" agriculture using artificial nutrients would have to be introduced, with the gravest risk of losing soil, characteristics of the habitat for fauna, and with absolute certainty, a significant part of the biological capital.

Population - Resource Balance

Given the lack of planning of population development in relation to available resources, we should remember facts of Latin American history and the conduct of the native inhabitants in the pre-Hispanic period. Taking that example, in this case, the Incas, we might meditate on the consequences of having violated, through cultural invasion, certain bases of conduct which might be valid in the present, and on the other hand, on the present situation of Latin America as the heir of cultural elements foreign to an ecological concept. At the present time (according to Luis Masson) it is still possible to find, in the area which is now Peru alone, a million hectares of *andenerias* or banked terraces for which, we must not forget, the mountain range itself was named; the range of the *Andenes*, and by a later deformation, the Andes. This million hectares, a non-eroded sector of Peru, still has structures which indicate that in 4000 B.C. irrigation agriculture was practiced (in agreement with Christian Gischler's observation.)

Assigning a regular size to the terraces we can see in San Pedro de Casta, from 300-500 square meters each, we can estimate that 20,000,000 terraces exist, only 20% of which are being used. To these it is necessary to add another similar number of terraces destroyed and worn down by erosion. it is notable that the Incas never built their cities on fertile lands, but only in rocky places, and that by the time the Spaniards arrived, the population of Peru can be estimated at 40,000,000. The conquerors caused small towns to be destroyed and their populations to be unified in larger centers; they captured or usurped extensive lands for themselves, isolated the indigenous groups, and interrupted the vertical relationship among ecosystems, a determining fact for the dynamic of the indigenous food supply, since originally crops were grown at different altitudes during different periods of the year, maintaining a regular food supply. Also the Inca reserved the coastal plains and the humidity captured by the vegetation, to be used only in periods of drought, approximately every 7 years. The conqueror put these lands into continuous production, and analysis of an aerial photograph of the litoral plains lets us see even now what where large farms were there is desert today. The conclusive fact is that by the year 1800 the population had fallen to one million inhabitants and is now only 18 million, because of new population growth accompanied by malnutrition.

Preservation of productivity

If that example is not sufficient demonstration of loss of productivity through human-generated environmental destruction in Latin America, it is possible to find other more recent examples from only 150 years ago, which are equally significant. Two mountainous regions, one of them of modest altitude, the Chilean coastal range, and the other steeper, the Venezuelan Andes, were very prosperous culturally, economically, and in terms of food production; both were sources of folk expression and customs, originating historically significant cultural directions, as much for Chile as for Venezuela, during the last century and the beginning of this one. In both regions during the same period, land surface estimated at 3,000,000 hectares was eroded. Because of the climate and the good quality of their soils, they were a vital food-growing resource which would be even more significant today if their productivity had been preserved.

The purpose of citing these cases is not to present a negativist position, but to criticize present culture so that this hard experience might be assimilated and serve as a stimulus to the cultural change which is so immediately necessary: the movement toward ecological culture.

Development

Obviously, there will be no true development if the quality of human life does not improve; there may be economic, industrial, commercial and cultural developments of various kinds, but these cannot be called Development, with a capital D, in the broadest sense of that term. In fact, it will be possible to speak of pseudo-development, of false or demagogic development, when the changes are mere expressions of developmentalist ideas, or bring consumerism along with them, creating circumstances which can be described as development by interested parties, but which in many cases mean further degradation of the quality of life.

Man depends for the quality of his life on the greater or lesser satisfaction of certain need factors: those whose impact is physiological, psycho-physiological, social, cultural and ecological. If these factors are deficiently satisfied, the impact will be negative; if they are satisfied at a sufficient level, they will provide the basis for the development of other higher levels of aspiration, generating a process of development towards Development, a growth whose limits cannot be foreseen in areas like the deepening knowledge of man himself, spiritual development, scientific knowledge, enjoyment of nature, etc.

Development so considered must be the product of an alternative culture, which does not ignore significant scientific and technological contributions, but which offers new point of view and which opposes present-day culture in its conception of the relationship of man to nature, natural resources, and the environment. This alternative culture would be drastically opposed to the irresponsible game which misuses nuclear energy to force the world's people into an unchangeable submission to power and draws the use of nuclear energy constantly further away from dialogue, meditation, rational planning and respect for human beings.

Let us think briefly of the aggressive and alienating effect of advertising and television programs, over the whole world, and other instruments of present-day culture which could perfectly well be re-oriented and revalued under an alternative ecological and conservationist culture.

Ecological and Conservationist Culture

The general directions or principles of ecological and conservationist culture, which will be discussed in this section, are not limits on the use of ecosystems and environments by man; they do not pretend to set nature up as a display to be contemplated and never touched; on the contrary, they bring, or better, bring together, general criteria for a more adequate relationship between man and the environment and its ecosystems.

Ecological culture is founded on an attitude toward the relationship between man and ecosystems which basically seeks to preserve balances -- the balance of energy capture by vegetation, or natural energy balance; the balance of kinetic energy from wind and the displacement of water, or the physical balance which has to be maintained to avoid soil erosion; the chemical balance based on the recycling of nutrients and on avoiding extractive or exhaustive use of the soil, instead limiting productivity to its capacity to regenerate fertility or to the addition of nutrients through recycling or the balanced use of fertilizers. These balances must be accompanied by biological balance, which requires on the one hand that species making up ecosystems not be lost and on the other hand, that these species not lose their capacity for association or their potential for repopulation.

Ecological culture also considers several general criteria for the use of ecosystems and the environment. In every place in which ecosystems are recoverable or where they have maintained their original characteristics, Development must be conditioned by and dependent on natural characteristics and potentials of the environment. Practices against this rule, that is to say, modification of the environment according to the goals of development, must be reserved for areas of the globe whose natural ecological characteristics cannot be recovered.

Other criteria which make up this culture are related to actions which respect the recuperability and elasticity of ecosystems, with the objective of not bringing them to a state of fatigue or breaking their elasticity, which would mean their definitive destruction. A similar criterion which promises to guarantee biological preservation is that of not taking irreversible actions, which means, for example, practicing deforestation while maintaining soil characteristics, preventing erosion and permitting reforestation with the same native species. This always requires previous study of species and their requirements for being replanted.

Sustained production should be a goal of ecological, conservationist culture, insofar as production has decreased in innumerable cases, such as in migratory agriculture or in the great eroded regions of Latin American we mentioned previously. Previous knowledge of ecosystems and environments is of fundamental importance in achieving sustained production and applying the above criteria. Adequate planning would permit dynamic processes, biological changes and impacts to be predicted, thus significantly attenuating their effect.

Obviously, this implies a rejection of the utilitarian egoism of immediate gain and thus, a cooperative, altruistic attitude. Along with ethical, social and human values, it means a massive cultural response from the community; instead of the imposition from above of utilitarian, egoistic decision, the sum of small individual decisions must prevail. This means the cultural pressure of a society with a clear conception of its dependent relationship to the environment and renewable resources.

Following the ideas of Schumacher, ecological culture does not accept that natural capital (soil, biological capital, ecosystems, etc.) be utilized, as it now is in many cases, with the criterion of profit. This criterion inevitably means the decapitalization of the true capital of man.

If in present-day culture, monetary capital subordinates natural capitals and makes them dependent to the point of degrading them and using them for profit, ecological culture assigns predominance to natural capitals and reduces monetary capital to a merely auxiliary role in development and human activity, which does not mean ignoring the importance of monetary capital, or even less of the economy, which can be reformulated under the conception of biological and ecological economy.

For ecological culture, the natural capitals of man belong to man himself, whatever his race, belief, level of culture, his creativity and his capacity for work constitute natural capital. Obviously natural capitals are integrated by the ecosystems pertaining to every human group, and the most important of natural capitals are soil capital, biological capital, and others.

Quality of Life

Since quality of life is synonymous with the degree of development of communities, it is fundamental to seek an evaluative model which will permit its relatively simple characterization and quantification. We are not pursuing a model which will give an exhaustive, detailed analysis, but one which can orient us in relation to the tasks of development, because in the last analysis, quality of life depends on innumerable variables and the relative significance assigned to them by each individual. Consequently, the objective is to provide an instrument of analysis and comparison, of global characterization and quantification, structured according to the separate analysis of variables and subvariables which make up each of the five need-factors most directly involved in the quality of human life.

The model is theoretical, permitting it to be applied without social, political, or philosophical prejudice, which would not be possible if the model had been constructed as an expression of the life characteristics of any really community considered as an ideal. The latter type of model would arouse prejudices against its acceptance, and obviously could not be applied to other social and environmental realities.

This model is made up of values applicable to typical communities of today's world; in atypical communities it would be necessary to establish equivalencies to facilitate comparison. This would be the case, for example, if there were no schooling divisible into years of study, but instead individuals taught themselves. In this case, it would be necessary to establish equivalencies.

Characteristics of the Model

Quality of life is considered as a function of five factors:

A. Factor of physiological impact
B. Factor of psychophysiological impact
C. Factor of cultural development towards individual participation in society
D. Factor of social conditioning
E. Factor of ecological dependence

Consequently: $QL = f(A; B; C; D; E)$

Each one of these five factors is given a score of 5 points for excellent; 4 for good; 3 for fair; 2 for bad; and 1 for very bad. The index of quality of life will correspond to the product of the scores obtained for the five factors.

Consequently: IQL = A x B x C x D x E

This permits us to obtain an index fluctuating between 1 and 3,125, distinguishing seven different categories of quality of life.

In turn, each factor is made up of variables calculated by means of matrices which allow the analysis of sub-variables of each matrix in different columns. By means of the scale already described, from five alternatives the value of each variable is calculated and the arithmetical average of the value of the variables integrating each factor is calculated, which gives us the value of the factor and consequently, allows us to calculate in a simple form the index of quality of life.

To present this model schematically, we will indicate each factor with the variables that make it up and a list of the subvariables considered in each matrix.

FACTOR A: PHYSIOLOGICAL IMPACT

Variable A1: Food and Nutrition

It is fundamental to know the quantity and quality, whether deficient or excessive, of the food the community eats to know its state of nutrition, available energy, and anomalies that might have an impact on this aspect.

Subvariables. Calorie intake, proteins, vitamins and minerals. Level of satisfaction of the sensation of hunger, organoleptic characteristics, and level of food sanitation.

Variable A2: Health

Logically, the study of physical and mental health is a fundamental indicator of the possibility of enjoying an adequate quality of life.

Subvariables: Percentage of the population that is ill; real access to medicine, incidence of infectious diseases, incidence of endo- and ecto-parasitism, frequency of non-infectious diseases, percentage of mental illness, level of knowledge of hygiene and health.

Variable A3: Environmental Sanitation

It is important to know the risk of physiological impact from pollution and contamination of the environment.

Subvariables: Availability and quality of water; interference of sewer effluents with human life; air quality; incidence of noises and odors; presence of garbage, heaps of slag or junk and pests. Finally, the level of cultural development in the relationship between man and environment.

FACTOR B: PSYCHOPHYSIOLOGICAL IMPACT

Variable B4: Housing

The characteristics of housing determine significant and important conditions for the human being from the psychological viewpoint, influencing energy recuperation, rest, affective and sexual life.

Subvariables: Useful surface area; stability; protection from external forces; isolation and privacy; comfort; functionalism; light; ventilation; facilities for food preparation and personal hygiene.

Variable B5: Environmental Aesthetics

The enjoyment and impact of environmental aesthetics transcends housing, because the average individual spends twice as many waking hours outside the living space as in it.

Subvariable: Scenic beauty of natural elements; beauty of human-generated elements in the environment; harmony of natural and human-generated elements; sense of appropriateness and pertinence of the image; and finally, social appreciation of environmental aesthetics.

Variable B6: Rest and Recreation

It's psychophysiological importance is rooted logically in the possibility of recuperating energies and enjoying life.

Subvariable: Sleep and rest; sports; programs and spectacles; children's games, vacations and short trips.

FACTOR C: CULTURAL DEVELOPMENT TOWARD INDIVIDUAL PARTICIPATION IN SOCIETY

The possibility of exercising and manifesting individual potentials, for and by means of the community.

Variable C7: Development of Aptitudes and Capacities

This is fundamental for the comprehension of one's own culture, and to be able to influence, in the modest form belonging to every person, tasks imposed by society, extending also the possibility of enjoying one's own cultural manifestations and those of the community.

Subvariables: Years of schooling; illiteracy; availability of teaching personnel; incentive to study; opportunity for and availability of study; and finally, degree of satisfaction in relation to achieved cultural aspirations.

Variable C8: Possibility of Effect Participation in the Community

Participation enriches community actions and permits each individual to accept or assume and in turn understand the criteria and norms of life which regulate his/her existence.

Subvariables: Level and type of participation, frequency and intensity of participation; freedom to participate and the significance of participation for the individual.

Variable C9: Work Adequate to Human Aptitudes

Constitutes one of the most relevant forms of participation of the individual in the community, can have impact on health and from a psychological point of view, can be accepted as something stimulating, as a contribution to the community, or as a form of alienation, frustration and control.

Subvariables: Effects of daily travel to work; length of work time, psychological and physiological effects of the activity.

FACTOR D: SOCIAL CONDITIONING

Variable D10: Psychological Conditioning Derived From Human Relationship

The degree of cordiality or aggressiveness, of definition or indefinition, of motivation or imposition in communication, constitute the positive or negative impacts of human relations in a society. Also, the imposition of premises derived from values alien to the interests of a community can have effects that deserve analysis.

Subvariable: Characteristics of interpersonal relationships; communication through mass media (radio, press, TV); relations depersonalized by noise, symbols, expressions. Relations with, or through, institutions.

Variable D11: Individual and Collective Security

This generates very powerful conditioning: fear inhibits; the preponderance of force humiliates and limits capacity for and exercise of human values, true intellectual development, and the use of potential human rationality.

Subvariables: Influence of warlike events; manifestations of social violence; delinquency, and finally, level of risk of accidents.

FACTOR E: DEPENDENCE ON ECOSYSTEMS

Variable E12: Balance and Productivity of Ecosystems

In direct and indirect ways, human beings depend on ecosystems and their degree of balance and productivity to supply them with food and basic materials. This, logically, affects the quality of life.

Subvariables: Potential productivity of the ecosystems on which a community depends; characteristics of biological and genetic capital; degree of soil conservation and productivity.

Variable E13: Ecological Stability

The rupture of environmental stability generates various possibilities of catastrophe, of greater or lesser magnitudes, which present risks for human life.

Subvariables: Risk of landslides, cave-ins, and floods, avalanches, mud slides. Risk of fire and natural phenomena with predictable effects.

Variable E14: Appropriate Use of Natural Resources

Corresponds to the criteria for use, which are constantly operating to project or inhibit potentials, to facilitate development toward an adequate population-resource balance, or to accentuate dependence on foreign ecosystems.

Subvariables: Criteria for use of land, degree of ecological culture; return of benefits to the community through use of renewable resources, characteristics of use of the environment and natural resources.

This model, as has already been indicated, has matrices used for each variable; these are elaborated for application to groups or representative parts of a community; they do not have validity for analyzing an individual's quality of life.

The model considers standard values without a measure of conformity and without underestimating the potential of underdeveloped countries, but considering man as a whole, without differences, consequently permitting the potential utilization of development.

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ENVIRONMENTAL EDUCATION IN THE ARAB STATES: ISSUES AND ACTIONS

by

M. S. Selim

Environmental education is one of the most effective tools available for dealing with different, complicated environmental problems. Such problems are becoming a major threat to the quality of human life on earth. Usually referred to as "environmental crises," these problems exist in all countries at various degrees of magnitude and complexity.

Once governments began to realize the gravity of environmental problems, emphasis was placed on the training of experts and technicians to meet such problems and laws were set to govern man's behavior and interaction with the environment. These proved to have little effect. First, laws are respected only if the purpose behind them is convincing. (For example, fishermen are often unconvinced of the need to limit their take; they violate regulations by using illegal nets or explosives in order to increase their catch.) Second, some laws are not even environmentally oriented. (In some countries young livestock of only a few weeks of age are slaughtered and laws do not prevent it.) Finally, major projects are carried out, especially in developing countries, without a thorough investigation of their possible environmental effects. (Egypt's Aswan Dam is a major illustration of this idea.)

To solve environmental problems, one must first understand them and then master the skills and abilities necessary to solve them. This can only be accomplished by developing a positive attitude toward and appreciation of a healthy environment. Some countries realize the necessity of developing these individual qualities. Other countries are only beginning to recognize the importance of this aspect of environmental education. A move towards the use of more effective environmental education programs is under way -- but at different stages in the countries of the world.

In order to present the state of environmental education in The Arab States, some relevant issues must be considered along with their effect on the programs of environmental education. A brief historical review of the conception of environmental education explains present activities.

Some Issues to be Considered:

--- The Arab region is one of many extremes:

1. not only very rich oil countries but some of the poorest by world measures;
2. countries with unlimited resources and others with very limited ones;
3. a few over-populated countries and some under-populated ones;
4. some poor countries with huge amounts of untapped resources, others with limited but well-developed resources;
5. some countries have generous supplies of fresh water while others lack any at all.

--- Environmental problems are always the product of the above conditions. In oil producing countries, pollutants are of a specific nature, different from those in agricultural countries. Desertification, although an acute problem in some countries like Sudan, is nonexistant in other areas. Population control is a sought after condition for over-populated countries, while rejected by under-populated ones.

--- Agriculture resources are well-developed in some countries and include every inch of cultivatable land. Where no cultivatable land exists, very modern technology is used for agricultural production independent of land resources. In others, millions of cultivatable acres are neglected.

--- Countries with available man-power and resources are developing industrial production. Countries with no resources or man-power are importing all resources for new industries.

--- Some Arab countries have well-developed man-power with an abundance of scientists, engineers, educators, technicians, medical staff, etc. Other strive to develop their man-power while importing different specialists from other Arab States -- and in some cases from even further afield.

--- All Arab Countries are governed by two major religions: Islam and Christianity. Both religions stress the importance of the environment, the interrelationship of environmental components, and the ways and means of protecting it. Religion is an important force guiding individual behavior.

--- Most Arab countries were occupied by foreign forces during different periods of this century.

Their areas of education were greatly influenced by the various foreign governments. Local environment was never a topic of education; all phenomena, specimens and lessons originated in the occupier's home environment. Now that Arab States are independent, they are working together to develop their own educational systems, based on the local and regional environment. Some countries possessing a more developed teaching staff, like Egypt, are helping other countries with limited staff. Some curricula and textbooks from the more developed countries are used by other Arab Countries, leading to a new regional cooperation which is still evolving.

--- The Arab States have much in common (religion, language, etc.) and are developing structures to strengthen their cultural unity. The Arab League was established in 1945. One of its most important departments, the Cultural Department, is responsible for activities in the areas of education, science and culture. In 1970, some Arab States felt that the task was more than a single department could handle and the Arab League Educational, Cultural, and Scientific Organization (ALECSO) was established. This organization, within the Arab League, is comparable to UNESCO in The United Nations System. Sub-regional offices have been established in places such as Riyadh, Saudi Arabia, to serve the Gulf States in the areas of education, science and culture. The establishment of such regional and sub-regional organizations makes it possible for the Arab States to exchange experts, projects, and -- above all -- to plan regional projects in different aspects of education.

--- Through these organizations, many problems of the region have been identified, including environmental problems. In addition, the convening of the Stockholm Conference in 1972 aroused worldwide concern and interest in managing environmental tasks and acknowledged environmental education as one of the most effective means of doing so.

Historical Background:

Environmental education developed in The Arab States as in many other cases through three stages.

1. Study About the Environment:

Study of the environment first gained importance during the 1940's. Curricula and textbooks used many local phenomena and emphasized the use of various examples from the local community. However, concept of the environment at that time

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was very limited. Some schools made the pupils study about the environment in the environment, with students spending weeks away from their schools. Most school subjects were artificially planned to serve such study methods. Mastery of facts was stressed as the most important objective of education and this program was considered a step forward towards realizing the importance of the environment as a laboratory for school activities.

2. Conservation Education:

During the last 1950's a few educators began to realize and foresee some problems in the environment related to management of natural resources. They tried to develop programs of conservation education through science curricula. Success of such programs was rather limited because many teachers failed to recognize any scientific significance. Parents and examination personnel also resisted this new scientific focus.

3. Environmental Education:

During the sixties, many environmentally oriented programs were developed in different parts of the world. The Biological Science Curriculum Study (BSCS) biology project, emphasizing the environmental approach, was one of these. Many Arab States were impressed by the idea and adapted it to their curricula (the seventies were the years of actual progress in environmental education). Because of world-wide interest, the UNESCO-UNEP program, the ALECSO project of environmental education, and the project of Integrated Science of ALESCO with a central focusing on core environmental concerns, environmental education concepts, objectives, and materials, were widely accepted among educators. Genuine efforts were started to promote environmental education at all levels of education.

PRINCIPLES, GOALS AND OBJECTIVES GUIDING ENVIRONMENTAL EDUCATION

Principles:

It is assumed that environmental education is extremely important for individuals, societies and the world community at large. In order to help solve different problems facing the environment, all education systems, mass media, et., should strive to implement successful environmental education and training programs. The following principles help in planning and implementing successful programs of environmental education.

1. All curricula and activities should include some aspect of environmental education. It should receive more emphasis in the sciences and social studies.

2. All levels of education, starting from pre-school to higher education and continuing education, should include environmental education.

3. Environmental issues should be included within the curriculum content of all subjects at the general education level. At the tertiary level, specific courses in environmental education are appropriate to serve the different specializations.

4. Proper values and attitudes are among the important objectives of environmental education. Knowledge alone may not help achieve such objectives.

5. The training of teachers and specialists in different aspects of the environment should be a continuous process.

6. Adequate teacher education is essential for a successful environmental education program. Basic information should be developed. Workshops are an effective means of promoting teacher' awareness of environmental matters.

7. A lag always exists between scientific research and curriculum development. Such a lag should be reduced in environmental issues.

8. The availability of information, technologies, and tools of evaluation are very basic for successful environment education programs.

Goals and Objectives of Environmental Education:

The educators' conception of the environment influences goals and objectives of environmental education. Objectives are usually stated in light of environmental conditions and learners' capacities. Objectives for the general education stage should differ from those of vocational and adult education.

At the general education stage (grades 1-12), objectives should vary according to the learners's age. At pre-school levels, concern should be directed toward developing certain habits. In the primary school, development of knowledge, understanding, and skills can be achieved through the different school subjects.

Positive attitudes toward, and appreciation of, the environment can be developed through all aspects of school and community life. Respect for public and private property can also be enhanced during this stage.

In the secondary school, objectives can be more specific, focusing on natural resources, pollution and other specific issues. The learner should develop a positive set of values and attitudes towards environmental problems, the skills needed to detect such problems and the abilities to solve them.

At higher and vocational education levels, more emphasis should be given to information and the ability to help make decisions in favor of the environment. Special objectives for each profession, i.d., engineers, chemists, industrialists, agriculture experts, town planners, and social leaders, should be stressed.

Environmental education for teachers should be considered a basic requirement. During their pre-service and in-service programs, teachers should acquire information relevant to the environment. The program should help the teacher to develop the expertise necessary to detect environmental issues and incorporate them into teaching lessons.

The following is a list of general objectives of environmental education program in the Arab States:

1. Develop an understanding of the environment and its impact on human life.

2. Present vividly the fact that all human activities and institutions are based on and dependent on the different components of the environment.

3. Teach the interrelations and interdependencies between man, animals, plants, and the earth that supports them all.

4. Dispel the notion that science and technology are substitutes for natural resources and capable of solving all environmental problems.

5. Develop the ability to sense environmental problems and solve those problems.

6. Sensitize the individual to the evidence of environmental abuse through pollution and waste of resource.

7. Develop positive values and attitudes towards the environment and appreciation of earth's complex interrelationships.

8. Expose problems of pollution, population growth vs. production and use of natural resources, and learn to present their consequences on the quality of human life.

ALECSO Program of Environmental Education:

In 1972 this writer conducted a survey of textbooks used in the Arab countries in the fields of science and social studies. By analyzing the contents of the books and teachers' manuals for environmental concepts and other components, the survey revealed that environmental education received very little emphasis.

In February of 1972, four months before the convening of the Stockholm Conference, ALECSO held a meeting in Khartoum, Sudan, to discuss different aspects of the environment. Mr. M. Strong, who became the first director of The United Nations Environment Programme (headquartered in Nairobi), attended this meeting. Environmental education in The Arab States was among the topics discussed. Representatives at the meeting recommended that ALECSO carry on a program of environmental education for the different stages of education. As a result, ALECSO planned and carried out an extensive program to encourage environmental education in schools, universities, adult education classes and, for the public, through mass media. All categories were planned for at the same time.

1. The Program of Environmental Education for Schools:

The first step within the program was preparation of a body of information to help curriculum planners, textbook writers, teachers and supervisors to incorporate environmental education within the curriculum content of all subjects at the general education level. A planning committee outlined the information needed, resulting in a resourcebook for general education.

a. The Resourcebook for General Education:

The basic idea of the book was to provide a source of information concerning environmental problems. The information was suitable for different levels of schooling and intended to help supply teaching materials suitable for the elementary, intermediate and secondary levels. Issues and problems in The Arab States and pertinent examples from other parts of the world were of major importance. Concepts, skills and attitudes were integrated within the different school subjects. Authors of the book considered the possibility that teaching special units on environmental education at the early stages of schooling would sound like preaching and could have negative results; they therefore attempted to avoid this possibility.

The resourcebook for general education is a 460 page volume consisting of fourteen chapters. It is a reservoir of information dealing with different aspects of the environment. Such information can be used to construct the environmental component of the curricula of the different stages of general education. Topics of importance covered in the book include, first, the conception and objectives of environmental education and the use of the book. Description of pollution, ecosystems, natural resources, plants, animals, water, soils, metals, deserts, atmosphere and weather, energy, population, and human settlements then follow. Some beliefs and superstitions explaining natural phenomena are also included along with case studies on some environments.

Each chapter has three parts: the first part covers the basic information treated for the various levels; the second part contains a comprehensive list of suggestions for educational implications for the different stages of general education; finally, the third part includes suggestions for references.

b. Guide to Use of the Textbook:

To make the best use of the textbook, experts planned a guide to be used by teachers, curriculum planners, textbook writers, and supervisors. The guide shows how the content can help supply necessary information, activities and teaching materials. Some concrete examples were included in the guide. It was published by ALECSO and distributed to The Arab States along with the resourcebook.

c. Curriculum Modules:

A workshop was held in Kuwait to help educators incorporate the content of the resourcebook in the different curricula. Teachers, supervisors, university professors and specialists in educational technologies attended. The group worked together for a period before dividing into three sub-groups. Each sub-group included teachers of the different subjects along with other members. Three curriculum modules were constructed, one for each school level: elementary, intermediate and secondary.

Teachers and experts of language, science, mathematics, arts, and music constructed the module for the primary school. The production of the module was a real pleasure for everybody in the group working together to stress environmental awareness through the school curriculum. The topic of the module was "My Environment."

The module for the intermediate school was constructed by another sub-group and blends language, science, social studies and mathematics. Its title was "Man and Natural Resources."

Experts in science and social studies constructed the module for the secondary school, and titled it "Energy."

ALECSO published three modules and sent them to all The Arab States. They were tried in some schools and proved to be successful. Other modules, constructed in different countries along th same lines, are also being used in the schools. Research done to evaluate the modules is encouraging and seems to prove the necessity for available basic information dealing with environmental issues if a environmental education program is to succeed. It was felt, however, that a shortage of evaluate instruments existed when judging the curriculum and its output.

The impact of the program is felt in many Arab States. Helping the teachers to build their own curriculum modules promotes their awareness and helps them both plan and carry out successful environmental education activities. Some countries are now constructing their science curriculum around a core of environmental education.

2. The Program of Environmental Education for the Tertiary Level:

The program for environmental education at the tertiary level started with another resource-book directed at the higher institutes and universities and higher institutes regardless of their specialization. Its contents constitute what is felt to be the basic minimum environmental information and skills needed by all citizens studying at the university. It was published through the cooperation of ALECSO-UNEP.

Because many university professors were unconvinced that such study was important, the book was less successful than at the lower education levels. Many colleges, however, are developing environmental education programs of their own for undergraduate and graduate students. Some colleges even initiated new diplomas in environmental sciences, and colleges of engineering and agriculture are reconsidering their programs in light of the need for effective environmental education programs.

3. Environmental Awareness Through Mass Media:

Realizing the importance of mass media in environmental awareness, ALECSO held training courses for newspaper writers and experts in radio and television in order to develop their acquaintance and awareness of environmental problems and improve their competency in dealing with environmental issues through the different media. During the training course, they produced radio and T.V. program for dissemination to the public.

As a follow-up of such activities, ALECSO publishes and distributes a bulletin to all experts of mass media in The Arab States. It contains articles for newspapers and scripts for radio and T.V. programs to be broadcast by local stations to the public.

As a result of this program, many environmental societies are now established in various countries and enhance environmental awareness by different means.

4. Teacher Education:

The important role of the teachers in carrying out successful programs of environmental education is well appreciated. ALECSO initiated efforts to introduce environmental education in the programs of both pre-service and in-service teacher education. In 1977, the deans of teacher training colleges in The Arab States met in Kuwait to plan for promoting environmental education within the programs of their colleges. The deans agreed that teacher education is an important field for the promotion of environmental education. Teachers can, through incorporating environmental problems in their teaching, provide leadership in schools. During extra-curricular activities, they also participate in community activities, extending their influence in promoting environmental education.

Many teacher preparation institutions in The Arab States now offer courses in environmental sciences to prospective teachers. Professional courses and practice teaching also involve concepts and methodologies. The College of Education of Ain-Shams University in Cairo, for example, conducts a program of in-service training to upgrade 146,000 elementary school teachers. An extensive, compulsory program of environmental science and environmental education is taken by all teachers.

Some National Activities in Environmental Education:

The ALECSO program encouraged The Arab States to start national activities in environmental education. Formal education and teacher training is emphasized more than in other areas.

--- In 1980, The Egyptian Ministry of Education carried out a survey of textbooks and curricula in order to analyze their content for environmental components. The Ministry prepared and published a comprehensive list containing concepts and principles to help educators environmentally enrich different curricula and activities. As a result, many textbooks now present environmental problems in a way that is natural, relevant to the subject and meets local needs of the student and community.

--- Leadership training is vital for effective programs of environmental education. In Egypt, many training activities are carried out for supervisors, principals, and other educations leaders. The colleges of education, in collaboration with the Ministry of Education, play an important role in such activities. A workshop, help in 1982 in Sinai, involved more than 70 leaders in an attempt to encourage environmental education through different school activities.

--- In Kuwait, the science program is being constructed around a core of environmental issues, using the environment as an integrating theme for all sciences.

--- In the Gulf States, the Offices of Education is carrying on an ambitious program in the region to promote environmental education and training.

--- The training of experts and specialists, who are usually the decision makers, is carried on at national and regional levels. Engineers, as well as experts in water supply, sewage, food quality, agriculture, industry, and pollution, are trained for better environmental management. They are also trained to use modern equipment and make decisions favorable to the environment. The program stresses the ability to detect and solve environmental problems.

Research in Environment Education:

Research in environmental education began rather slowly in The Arab States because of a shortage of competent personnel qualified to conduct such research. At the present time, many institutions and universities are responsible for research in different areas of environmental education. The following are some examples:

A. Research in the Field of Curriculum:

Many aspects of curriculum development and evaluation were covered by research.

1. Curricula and Environmental Education Objectives:

1.1 One study evaluated the contribution of secondary school biology and chemistry to environmental education in some schools of Egypt. The curricular content was analyzed and criteria were developed to evaluate its relevance to environmental education. An achievement test and attitude scale were constructed and administered to the students before and after participation in biology and chemistry courses (a control group did not take such courses). Test results showed the courses effectively developed concepts of ecosystems, natural resources, and environmental pollution. Students' attitudes regarding natural phenomena, environmental rights, and environmental protection showed significant improvements.[1]

1.2 Another study compared the effect of teaching a unit on pollution, as it is usually taught in the biology course of the tenth grade in Egypt, with the Biological Science Curriculum Study (BSCS) type unit on pollution. Results showed that there were no significant differences in achievement and in attitudes.[2]

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[1] Research supervised by the writer, College of Education, University of Mansoura, 1981.

1.3 A final study evaluated the effectiveness of the program of the intermediate school (7-9) in developing positive attitudes towards the environment. Results showed significant improvements from the scores of students entering and those leaving the school. Students, however, felt that the curricula did not greatly change their attitudes. Interviews with the textbook authors of the intermediate stage revealed most were not environmentally oriented while writing the books.[3]

2. Curriculum Modules:

Research in this area mainly concerns the development of environmental education programs within the curricula of the different school subjects. A study of this type was done for Egypt, and another completed in Kuwait.

2.1 In Egypt, an attempt was made to develop environmental education through the social studies curriculum in the secondary school. Concepts and subconcepts were identified and integrated within the curriculum. A detailed unit was tried out in some schools and proved to be effective.

2.2 Another recently developed project integrated environmental programs with science studies (for grades 5-8) in the schools of Kuwait. Environmental ideas provided the integrating core. Tried out in a number of schools, the unit proved very effective in helping students develop environmental concepts, skills and attitudes. The program suggested by the study is to be experimented with and implemented in the schools of Kuwait.[4]

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[2] Amer,Ibrahim. "A Comparison of Two Environmental Education Programs: A Pollution Unit as Used in Egyptian Sec. Schools, and a BSCS Type Pollution Unit, as Measured by Achievement and Attitudes," The Pennsylvania State University, 1980.

[3] Afifi, A.H. "The Effect of Preparatory Stage Curricula on Students' Attitudes Towards the Environment," College of Education, Ain-Shams University, Cairo, Egypt, 1981.

B. Research in Teacher Education:

Research in this area mainly concerns the development of courses in environmental education for prospective teachers and for in-service training. Criteria are set for evaluation of the present programs. Results from an experimental study in Jordan with a program of environmental education in teaching institutes is very encouraging.[5]

C. Research in Engineering Education:

Since engineers are important decision makers in environmental matters, a study in Egypt reconsidered the programs of engineering education and its emphasis on environmental education. Curricula of all engineering colleges in the country were analyzed; very little was found promoting environmental education. A program of environmental education for engineers during their undergraduate and graduate studies was then outlined and carefully examined by a group of senior experts concerned with the different aspects of engineering (i.e., transport, irrigation, water supply, sewage disposal, town planning, architecture, and industry). They introduced some changes to the suggested program and a unit of the proposed program was then tried out in one college in Cairo. Evaluations of that program proved it to be an improvement to engineering education in Egypt.[6]

Research in Agricultural Education:

Environmental issues are not as important as they should be in the the education of agriculture experts at the university level. A study attempted to develop programs which would enrich the different activities in the colleges of agriculture when environmental issues and problems were involved. A survey of the current programs analyzed them for environmental concepts and skills and a program was planned for the colleges in Egypt. Part of this program was successfully implemented in one of the colleges in the Delta.[7]

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[4] El-Sharrah, Y.A. "A Program of Environmental Education in Science for Intermediate Schools of Kuwait," College of Education, Ain-Shams University, Cairo, Egypt, 1984. (study supervised by the writer).

[5] El-Mislimany, I. "A Program for Environmental Education for Elementary Teachers in Jordan, A study in its Final Stages," College of Education, Ain-Shams University, Cairo, Egypt (study supervised by the writer).

[6] Study supervised by the writer, College of Education, Ain-Shams University, Cairo, Egypt, 1984.

Research in Adult Education:

Two Egyptian studies were conducted in this field. One took place in a rural area, the other in an industrial area. A survey of each area's problems was completed and an environmental education program outlined as a result. The program aimed at helping adults understand and solve important environmental problems. The programs were offered to samples of adults in the two areas and results were evaluated and proved more effective than present practices.[8]

Conclusions and Recommendations:

All The Arab States are aware of the importance of environmental education as the most effective means of protecting the environment. Specific issues should be considered in planning for effective programs of environmental education, especially since such programs are in different stages of development in the different Arab States. More emphasis is given to the programs of the pre-university education. Research is dealing with different aspects of environmental education, but more research is definitely needed in this field. More researchers are getting interested in dealing with the different problems on environmental education and the situation is improving.

To help plan for effective programs of environmental education in The Arab States, the following recommendations are offered:

1. Institutions responsible for training leaders from the region must cooperate in planning a strategy, development of environmental education programs, and supervision of the implementation of their different activities. This cooperation could be achieved through institutions, e.g., universities, mass media and professional organizations.

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[7] Study supervised by the writer, College of Education, Ain-Shams University, Cairo, Egypt, 1984.

[8] Study supervised by the writer, College of Education, Ain-Shams University, Cairo, Egypt, 1984.

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2. Developing and implementing successful environmental education programs is dependent on the availability of resource materials. This should be achieved through international, regional and national efforts.

3. A shortage of evaluative materials for the assessment of effectiveness of environmental education programs exists. Help should be provided in constructing different types of tests and criteria and assisting the experts in each country in the use and interpretation of results.

4. Since environmental education should be a major aspect of education, it is suggested that subregional centers for environmental education be established. These centers could develop and prepare curriculum materials and teaching aids and help to train personnel and leaders in the different areas of environmental sciences and technologies.

5. Planned research activities should be implemented cooperatively by universities and centers in the region. Efforts should be made to train the necessary personnel for this vital aspect of environmental education.

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THE WORLD CONSERVATION STRATEGY AND SCOTTISH EDUCATION: AN INVESTIGATION OF STRUCTURE

by

J. C. Smyth

ABSTRACT: The World Conservation Strategy provided all concerned for the quality of their environment with a clear statement of what measures are necessary to reverse its current deterioration. The global strategy has now been followed in some countries, including the U.K., by national strategies which offer more specific advice. This paper deals with the contribution that these documents make to the subject matter and treatment of environmental education and suggests how they may be related to its conceptual structure, using as the model a structure recently developed in Scotland for use in Scottish schools. While the objectives of environmental education identified in this scheme are stated in terms of the development of concepts, skills and attitudes rather than the acquisition of factual knowledge, it is suggested that the conservation strategies offer useful guidance for selecting relevant studies from which to cultivate these qualities. In this way a programme may be devised which will subscribe to the objectives of both environmental education and environmental resource conservation.

Introduction

In the last paragraph of her last book Progress for a Small Planet, Barbara Ward described the inescapable physical interdependence between man and environment as the chief new insight of our century. Two sentences earlier she identified humanity as constituting the only insoluble problem to achieving a balanced and conserving planet, as indeed many other have done. Those sentences, quoted by Brian Johnson (1983) in his overview of the United Kingdom response to the World Conservation Strategy (WCS), summarize well the predicament which the International Union for the Conservation of Nature and Natural Resources (IUCN) attempted to tackle by producing the Strategy in 1980. One might fairly regard WCS and the further constructive documents which it has stimulated as the most promising response to the problem, prepared as they have been through widespread international discussion.

The complex and deteriorating relationships between man and environment which led to publication of WCS are the same which stimulated the appearance of environmental education, some years earlier, as a new entry in the educational vocabulary. It is therefore reasonable to see in the one a resource of great value for the development of the other. Indeed they are interdependent. This paper attempts to examine some of the ways in which these newly organized ideas of global ideas of global management might be structured into an environment education programme. It takes as its case for study the Scottish education system and lays most emphasis on conditions in the secondary school (i.e. age 12 and over) since this is arguably the core of most people's formal education. First, however, we look more closely at WCS and the further documents which it has stimulated.

The World Conservation Strategy

The decade which preceded publication of WCS was one of increasing activity among international agencies concerned with environmental issues. The Stockhom Conference on the Human Environment in 1972 led to the establishment of the UN Environment Programme (UNEP) which, alongside environmental monitoring, an information service and many other projects, collaborated with UNESCO to set up, in 1975, an International Environmental Education Programme which is still continuing. Regional workshops and meetings of specialists led to the intergovernmental conference at Tbilisi in 1977 which set out for a world audience what environmental education should be (UNESCO, 1978).

IUCN was founded in 1948, with an international membership of both governmental and non-governmental organizations, a combination providing greater freedom and flexibility than intergovernmental organizations, a combination with UECSCO and UNEP and with the support of the World Wildlife Fund (WWF) and the UN Food and Agriculture Organization (FAO), IUCN put together WCS, through many drafts and international discussions, and published it in 1980. It was welcomed as a clear statement of the measures needed to created a healthier environment for mankind, and received prestigious launching by heads of state and senior ministers in 34 countries.

Although it was primarily a statement of the principles upon which policies of conservation and sustainable development should be founded, the authors of WCS recognized the need for supporting education policies and included a section suggesting how they might be tackled. The main value of WCS to education, however, must lie in its statement of principles and the authority of their delivery. These should provide the subject material round which may be generated the process of educational renovation that had already been prescribed by UNESCO in 1977.

The objectives of the Strategy are fundamental: maintenance of ecological life-support systems, maintenance of genetic diversity, and sustainable use of species and ecosystems for development. Its authors thus gave conservation a meaning which underlies all the diverse interpretations accorded to it by more specialized interest groups. The draft New Zealand Strategy (1981) called for adjustment of the depletion rate of non-renewable resources to one which would allow time for transition to more abundant materials and to sustainable, renewable resources. It also made provision for cultural, spiritual and other non-material needs of society. This objective was also recognized in the Welsh response to WCS (Jones, 1982) which included a section on the Welsh cultural heritage.

Two features of WCS constitute important progress in the presentation of conservation to the public and account for much of its credibility with the governments of poorer countries. One is its recognition of human society as a part of the system to be conserved, and as a result the emphasis on continued (but sustainable) development to reduce the urgent human needs which so often have been treated as a separate and conflicting set of problems. A difficulty of this is that both environmental practitioners and educators trained to handle the complex issues of ecological conservation are rarely skilled in the equally complex economic, social, technological and political issues of development, and visa versa. If this difficulty is to be no more than temporary some major revisions are needed in the education and training of both conservationists and developers, and of educators dealing with environmental subjects.

The other critically important progressive feature of WCS is that it aims to be active rather than reactive, to incorporate conservation principles into planning processes rather than to struggle with rescue and rehabilitation attempts, a more familiar function until now. Educators will miss the boat if they cannot respond quickly enough to do likewise.

National Strategies

As a global strategy WCS necessarily dealt to a great extent in generalities. For both practical conservation measures and for the educational programmes needed to sustain them it was foreseen that the global statement would have to be followed by national strategies which would apply WCS principles to the particular conditions of individual countries. This has been done, or is in progress, in several countries (the New Zealand version has already been cited). The UK launched its response in 1983, after an intensive process of discussion between many different organizations and individuals, dividing its subject matter between seven sections dealing with industrial, urban, rural, marine and coastal environments, overseas environmental policy, environmental ethics and education. An overview report drew together the many ideas and recommendations from these groups and proposed in addition ten strategic ways to action. These documents offer more specific advice to environmental practitioners and educators in the UK than the global strategy could ever do. A gap still exists, however, between the national recommendations and the practical needs of local conservationists and classroom teachers. A third tier of responses could help to fill the gap - in the UK, for example, we now have a national conservation strategy prepared by the Nature Conversancy Council (1984) and also the broadly based Welsh Strategy already mentioned. More of these responses are needed however, specific to activity or geographical area, and then a fourth tier of response translating them into action strategies. What might this imply for education?

WCS and Education

To be widely successful the authors of WCS recognized that practical remedial actions to conserve the environment call for the modification of human behavior on a global scale, not just of decision makers and environmental interveners but of the general public whose lives will be altered thereby. This is primarily the task of educators, to provide people with the knowledge and understanding, skills and attitudes consistent with the new environmental ethic which achievement of WCS objectives demands. If this seems an impossible target one can at least reflect that the environmental problems to be resolved are products of the very rapid adaptability of human behavior (in contrast to other processes of natural change) and that this same speed, if property directed, might save the day.

Relating conservation to education has not hitherto been easy except in a few special contexts. Conservation has itself evolved fairly quickly from more restricted ideas of preservation and is still apt to be regarded an an attempt to maintain the exotic and the picturesque at the expense of measures to relieve more obvious immediate problem of poverty and malnutrition, of unemployment and boredom. The objects of conservation also vary confusingly between different promoters: nature and natural resources, landscape quality, historic buildings, works of art, standards of living, population control are only a few of the things which different people think of when they use the word. To those especially who live and work in socially and environmentally deprived urban industrial areas it is difficult for conservation to be made both clear in its objectives and relevant.

For practical purposes, therefore, conservation education must be incorporated, at least in the formal school sector, in more broadly defined environmental education. The UK response to WCS has greatly eased this by its inclusion of the urban and industrial environment and by its extension of WCS aims for UK action into three broad areas:

(a) Integrating conservation of both living and non-living resources with development;

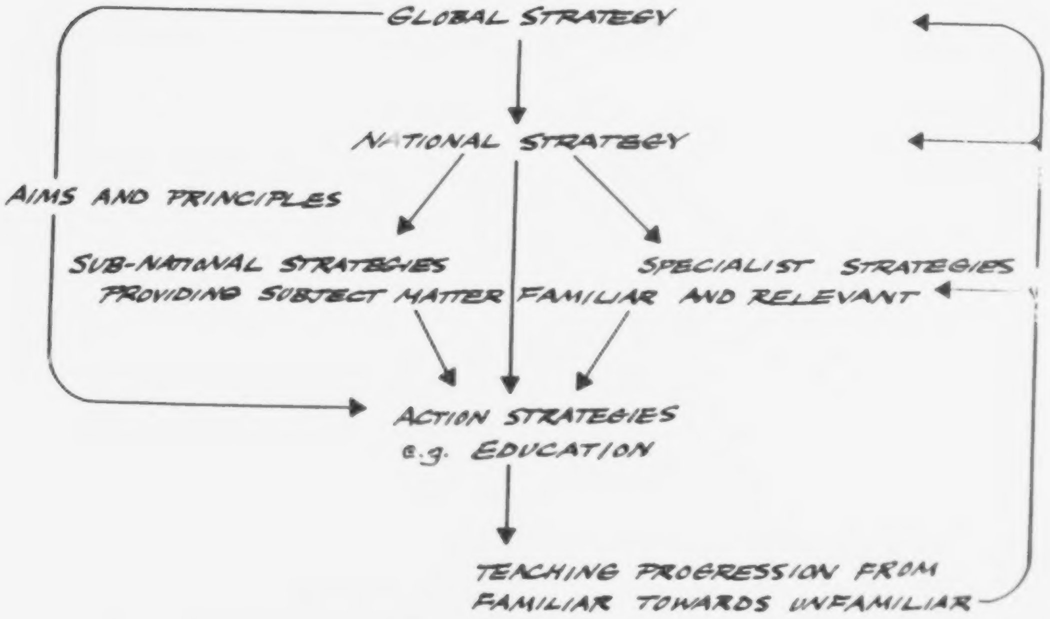
(b) developing a sustainable society, which both physical and psychological needs are fully met;

(c) developing a stable and sustainable economy through practices of resource conservation in all spheres of activity.

By these means conservation ceases to be presented as a fringe luxury and becomes a primary objective of environmental education in any of its definitions. This is an important advance since there are places where environmental education has developed with little reference to conservation education as understood by IUCN, and little admission of its relevance to the lives of people. The third and fourth tiers of response already mentioned should further sharpen the relevance of conservation strategies to everyday life. In the case of education, action strategies imply, for example, the design of practical projects and teaching materials appropriate to the locality. Figure 1 summarizes these relationships.

To carry these insights through to educational action strategies we need the collaboration of representatives from several different subject disciplines and from a a range of specialist organizations. This can be done successfully if they are given something fresh to do together. One difficulty that may have to be overcome, however, lies in the varying definitions of education. Conservation groups, anxious for quick results in public support, may prefer to meet their educational needs by provision of selected information in an attractive and quickly assimilable form directed towards molding opinion on a limited conservation issue. Educators on the other hand place priority on drawing out the talents of the student for longer-term benefits. The former approach is focused on the object of the activity, the latter on the subject who acts. Both approaches, of the propagandist and of the educator, have their roles in the adaptation of human behavior and are inter-dependent, but ought not to be confused. This understood, the role of the specialist in constructing teaching programmes is vital: in a field of study so complex, varied and far-reaching, the dangers of promoting under-researched and over-simplistic solutions to problems are huge and expert guidance is essential.

FIG. 1. RESPONSE TO THE WORLD CONSERVATION STRATEGY


GLOBAL STRATEGY
NATIONAL STRATEGY
AIMS AND PRINCIPLES
SUB-NATIONAL STRATEGIES
SPECIALIST STRATEGIES
PROVIDING SUBJECT MATTER FAMILIAR AND RELEVANT
ACTION STRATEGIES
e.g. EDUCATION
TEACHING PROGRESSION FROM
FAMILIAR TOWARDS UNFAMILIAR

Having outlined the structure of WCS and its growing family of strategies, and noted the relationship of education to these, we may now consider how they should interact constructively. Since the Scottish system is to be used as a case study a brief account of it may be helpful.

Environmental Education in Scotland

Environmental education in Scotland has been the subject of a recent review (Scottish Environmental Education Council, 1985). Briefly it may be said that the Scottish system of education which is both separate and different from that in other parts of the U.K., is traditional and subject-centered, strongly directed towards the requirements of certificate examinations, and not therefore easily penetrated by new and unproven schemes of work. Although there are now many environmental teaching projects scattered through Scottish schools, some of which acknowledge the value of interdisciplinary approaches, they are poorly coordinated and do not contribute to certificate work; thus they tend to receive a low rating from both the administrators and recipients of education.

Nevertheless progress is being made. Recent curriculum changes have led to the introduction of some new and potentially interdisciplinary courses with environmental components, and a start made to the inclusion of more environmental approaches within traditional curriculum subjects. Unfortunately these reforms are still unlikely to touch the more able pupils from who future decision-makers should be recruited. There is also little co-ordination in environmental teaching either between primary and secondary schools, among the different subject of the secondary curriculum, or even within individual schools. A central policy, and machinery for coordination both between and within schools have all been recommended but may still take time to materialize. If the more able pupils are to be included in environmental programmes these will have to be introduced through the main curriculum subjects that lead to success in certificate examinations and are thus rewarding to pupils, teachers and parents.

An earlier discussion of the problems involved in promoting environmental education in Scotland (Smyth, 1980a) confirms that little has changed in recent years, save that for teachers the pressures of new schemes of work combined with diminishing resources have made participation in innovative experiments more difficult. There is now, however, a clearer understanding of what the structure of an environmental unit might be, following the development of a teaching model by the Strathclyde Environmental Education Group (1985) in the west of Scotland (also described by Forbes and Smyth, 1984).

Returning to the need for an action strategy to incorporate the principles of SCS in environmental education, we may now look to this teaching model as a structuring framework for the course material which might be suggested by a locally-orientated conservation strategy.

Fitting into a Structure

Generally three sets of determinants are involved in design of any educational programme - those relating to the subject matter of the course (epitstemological factors), those relating to the circumstances in which it is being presented (social, environmental and ideological factors) and those relating to the developmental stage of the people to whom it is addressed (psychological factors). The little working parties of practicing teachers and topic specialists who might meet at the fourth tier of response to put together an action strategy for environmental education should find that WCS documents offer as good guidance to potential subject content as any we have had. Selection thereafter is guided by the other determinants which will naturally vary with the circumstances in which the programme is presented.

Three points are stressed:

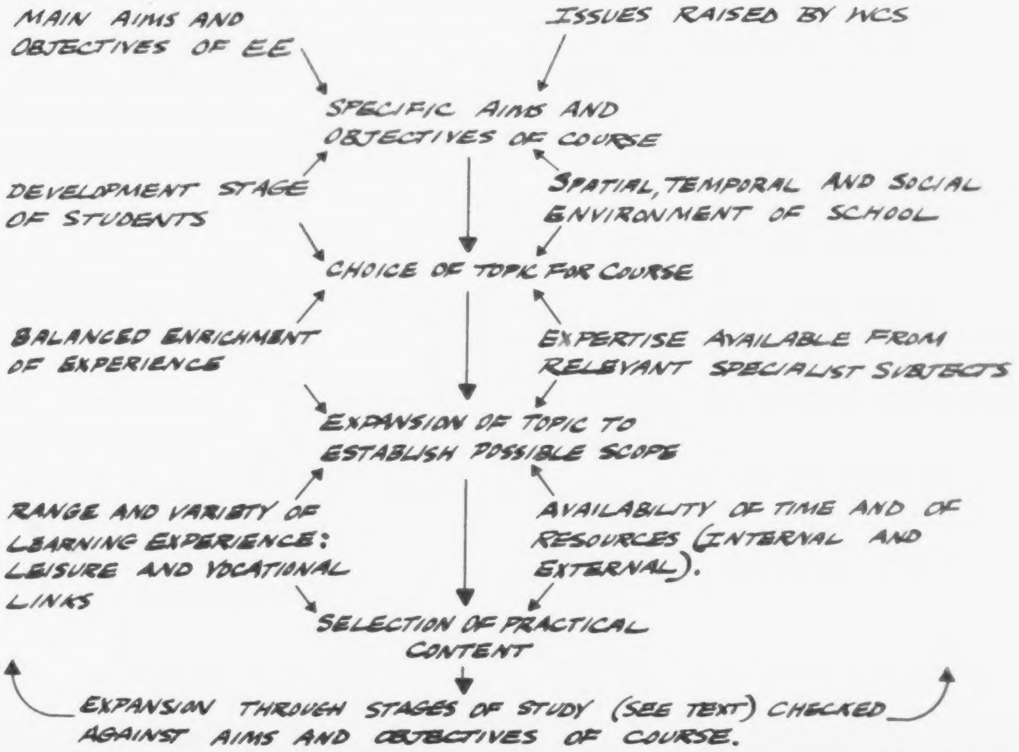
(i) In the treatment of any issue the perceptions and skills of as many as possible of the relevant specialist interests ought to be drawn in. In practice the variety of directions through which a topic can be expanded may be determined by the skills of the available teaching team but the multifaceted nature of most environmental issues calls for as wide a spread as possible.

(ii) Because of the variety and complexity of the subject area, emphasis is on concepts and approaches, skills and attitudes rather than on a pre-determined body of knowledge.

(iii) Teaching should move outwards from an environment which is familiar and important to the student into less familiar fields defined in terms of space, time and other people; it should also take into account the internal environment of the individual expressed both in terms of physiological processes and needs and of the mental world of imagination and creativity (these points are discusses more fully in Smyth 1983a).

The process of fitting desired content into a structured programme is summarized in Figure 2, leading to the teaching model already mentioned. The model was

FIG. 2 DEVELOPMENT OF A COURSE, USING WCS, FOLLOWING THE STRATHCLYDE MODEL


MAIN AIMS AND OBJECTIVES OF EE
ISSUES RAISED BY WCS
SPECIFIC AIMS AND OBJECTIVES OF COURSE
DEVELOPMENT STAGE OF STUDENTS
SPATIAL, TEMPORAL AND SOCIAL ENVIRONMENT OF SCHOOL
CHOICE OF TOPIC FOR COURSE
BALANCED ENRICHMENT OF EXPERIENCE
EXPERTISE AVAILABLE FROM RELEVANT SPECIALIST SUBJECTS
EXPANSION OF TOPIC TO ESTABLISH POSSIBLE SCOPE
RANGE AND VARIETY OF LEARNING EXPERIENCE: LEISURE AND VOCATIONAL LINKS
AVAILABILITY OF TIME AND OF RESOURCES (INTERNAL AND EXTERNAL).
SELECTION OF PRACTICAL CONTENT
EXPANSION THROUGH STAGES OF STUDY (SEE TEXT) CHECKED AGAINST AIMS AND OBJECTIVES OF COURSE.

initially prepared for use in formal secondary education (ages 14-16) and has been successfully used both for special interdisciplinary teaching units and for the treatment of environmental topics within a specific curriculum subject. It is considered to be adaptable to other levels of education, by varying the emphasis on particular stages of study (see below), and also in informal education (as yet untested). As a guide to treatment of the material the group prepared a set of objectives of which a condensed version is given Table 1. This is intended to cover the whole range of environmental education over a student's learning period, and individual units may only contribute to parts of the whole.

The model is topic-based and its core structure is a set of progressive stages of study of the topic emphasizing, in turn, development of awareness, of understanding of evaluation and of planning for action, presented as five questions:

(i) What does it look like?

> (Direct and indirect observation made primarily on local material).

(ii) How did it become like that?

> (Comparisons of observed and recorded data to introduce a timescale).

(iii) How does it operate?

> (A study of inter-relations, processes and functions involving analysis and synthesis).

(iv) How does it change?

> (An investigation of the reasons for present and past changes).

(v) How can change be guided?

> (An exercise in evaluating different kinds of change and exploring how to participate in determining the course of change).

Obviously these questions must be adapted to the choosen topic, and given emphasis appropriate to the level of student group. The questions are then further sub-divided into more specific questions appropriate to the particular circumstances of the school, to provide a detailed set of course objectives. These can be classified in a conventional way into knowledge, comprehension, higher abilities, communication, practical and attitudinal objectives.

TABLE 1

MAIN COURSE OBJECTIVES
(from Strathclyde model 1985)

FACTS & CONCEPTS

Inter-relations - especially between man and environment
The dynamic nature of the environment
Accelerating rates of change
Influence of technological and socio-economic factors
Finite, non-renewable resources and renewable resources
Man's dependence on wise management
Control of change
Conflicts of interests.

SKILLS

Critical observation, interpretation and evaluation of data
Recording and displaying data
Communication
Making and evaluating hypotheses
Constructing models of environment
Sampling opinions
Solving problems
Collaborating with others.

ATTITUDES

Realisation of one's own worth
Respect for others
Value of the natural environment
Concern for improvement
Preventing misuse, vandalism, pollution
Confidence to be involved in environmental improvement
Willingness to work out solutions with others.

Course materials are assessed, both before and after trial, against the objectives which they have been designed to attain, both the general set of objectives and the set expanded and adjusted in conformity with the main course determinants for each particular teaching situation. Unit modules are checked against these for variety and success. Courses made up from several modules may likewise be checked for coverage, for level and for achievement, and indeed the process could be extended to assess the quality of development of environmental education through an entire school record.

Choice of Content

The WCS documents now become useful as a means of selecting topics for treatment with the above structure. While concepts, skills and attitudes are the objectives rather than factual knowledge, these are most likely to be acquired from involvement with topical issues relating to relatively familiar experience. For someone embarking on the design of a course the process might be divided into two stages.

However important one may regard a multidisciplinary approach to understanding the man-environment system, the practical starting point will often been an established academic discipline, if only because formal education systems tend to be structured in that way and progress cannot be made otherwise. The first step is therefore likely to be an assessment of the environmental connections associated with a particular discipline. Appendix 1 is an example of the kind of prospectus which might result from such an assessment, drawn up by a subject specialist developing applied environmental topics from his own discipline (in this case biology, although, as the ideas become more applied to human life the need for other specialist inputs becomes apparent). It is not at this stage focused on any particular age group or academic level: These considerations will help to determine what is selected from it at the next stage. The assembly of a true interdisciplinary course might also be preceded by similar exercises carried out by other available subject specialists in the team, and the results combined to draw together the many similar or overlapping topics and issues that would emerge. Alternatively, if the system did not permit incorporation of interdisciplinary courses, the prospectus might lead to a subject-based treatment into which people from other subject disciplines were drawn as guest tutors or consultants.

Only in a rather academic institutional context would such a prospectus be used as the basis for an examinable syllabus, emphasizing the cognitive elements of the left-hand column (Appendix 1). Following the model proposed the left-hand column would indicate important contributions to teaching that a biologist might make, but the starting points would be located from the centre column, emphasizing environments of identified relevance to the particular student group and defined as topics appropriate to the model. Their contribution to appreciation of the kinds of issues and concepts suggested in the right-hand column would be more important than the sum of factual knowledge represented on the left, which would operate here as the means rather than the end.

Now the contributions that a subject discipline can offer to environmental understanding may be set alongside the environmental needs identified by conservation strategies. In this second stage, the choice of topics from such a prospectus, could be guided by the recommendations of WCS. The items in the right-hand column all contribute to understanding of the main objectives of the global strategy. In structuring a set of topics it would be beneficial to include those which helped to underpin each of it main objectives.

National and sub-national strategies, such as the UK Conservation and Development Programme (CDP) with its recognition of social and economic sustainability alongside that of natural resources, should help to guide selection of topics from the centre column. It would be impossible to review here all the 169 recommendations and many other suggestions contained in the CDP for their relationships with education. As an indication of their usefulness, however, we may take as an example someone working in an urban environment who might well turn for ideas to part of the CDP, "The Livable City", a report by Joan Davidson and Ann MacEwen. The following condensed description of this section is quoted from a review of the CDP published in Scottish Field Studies (Smyth, 1983a).

> Cities continue to grow, in the Third World very rapidly, and the expectations of a better life which draw people to them are often sadly forlorn: the declining state of our own inner cities is a warning that conservation principles need to be applied in the urban environment as in any other. This report examines thoroughly the resource base upon which city life is founded, the implications of consumption and the need to save, the opportunities and problems for conservation presented by changes in patterns of development, management and way of life. The authors build up an eight-point strategy for integrating urban development with resource conservation based on their judgment that urban areas must be leaner on resources and become richer in the skills of using them. To be leaner on resources urban areas must be:

(i) Low on energy (energy saving based on energy conservation in buildings, transport and equipment, appropriate pricing and increased awareness);

(ii) Thrifty with land (promoting urban regeneration, controlling development and effectively managing the urban fringe);

(iii) Long in life (rehabilitation rather than replacement, designing for long life and adaptability, replacing and maintaining utilities, improving the performance of the building industry);

(iv) Making wastes work (save on land-use and transport, promote treatment of wastes, recycling and re-use, reduce packaging;

(v) Reducing pollution (establish stringent quality objectives for air, water and soil, control emissions0;

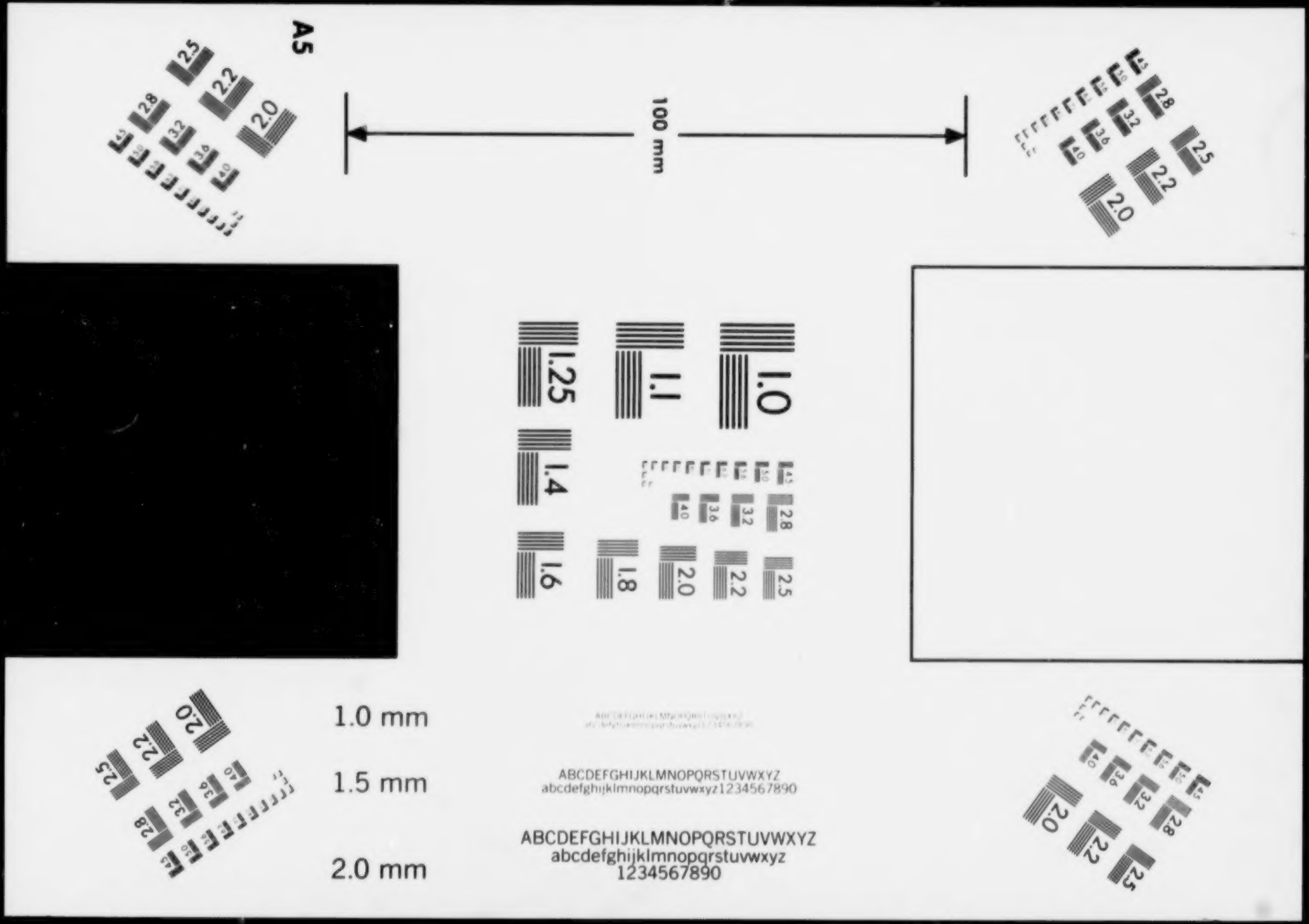
(vi) Greening and growing (protect and create greenspace, enhance the visual environment, provide for recreation and education, encourage growth of food and trees).

To be richer in the skills of doing more with less:

(vii) Think strategically towards resource saving (coordinate and integrate development and conservation, develop resource auditing and budgeting);

(viii) Act locally (increase local initiatives in regeneration combining resource saving with job and wealth creation).

The authors recognize some familiar obstacles e.g., lack of public awareness, institutional inertia, lack of investment, the land market, lack of research and of skills, the tyranny of the car, the development of labor, but they come up with some priorities for action that they consider urgent. These include major initiatives to be taken by central and local government, and the private sector, ranging from district heating and integrated transport programmes to use recycled paper, lead-free petrol and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better after care of planted trees. They lead off with the need for government commitment and finish with the need for public awareness.

It is easy to see how a set of topics relevant to the objectives of WCS, to the lives of urban children and to the objectives of environmental education could be drawn from this and provide a range of activities and experiences, in surroundings both familiar and important to the student. How these might be selected and directed would of course depend on whether the course units were contained within a single curriculum subject or in a truly interdisciplinary course.

In choosing one particular section of the CDP as an example it is important to remember also the relevance of the other parts, on rural, coastal, industrial and overseas environments and on the ethical issues which lie behind them. In a balanced course it would be necessary to spread a choice of topics through all of these and to remember also the strength of the inter-connections between them.

Conclusion

The development of environmental education courses, according to the suggestions made here, combine two things:

(i) A model setting out the objectives of environmental education, a logical treatment of topics, a guide to establishing connections with the different branches of knowledge or expertise relevant to the topic, and the means by which a course may be evaluated.

(ii) A statement of the conditions needed for a stable relationship between man and environment on a global scale, adapted by stages to more local circumstances, and recognizing both how the environment should be maintained and how human behavior should be adjusted in accordance with the needs of a healthier system; this offers guidance to relevant teaching topics and to how they may be treated for the benefit of both education and conservation.

Will the inclusion of appropriate topics in structured teaching programmes - if it can be achieved on a sufficient scale - meet the educational needs of WCS? Probably not: there is a need for more radical rethinking of education and for more extensive changes than are within reach of groups of enthusiastic teachers. These concern the realignment of educational philosophy and the reconstruction of curricula to take account of a redefined relationship between man and environment. Much thought must also be given to the environment in which education itself takes place, both formal and informal, the educational consequences of many other policies seemingly unconnected and the influence of opinion-molders of many persuasions whose objectives may be altogether contrary. It is for such concerns that we need a World Environmental Education Strategy.

Can it all work in educational systems notorious for inertia, and as yet showing little sign of responding convincingly to warnings of inadequacy? The changes in lifestyle implied by the recommendations of the U.K. Conservation and Development Programme, even although they are described as initially applicable "flexibly and progressively, without vast investment, revolutionary legal changes or unrealistic human responses", will need a prepared public to receive them. Other (friendly) molders of public opinion can, of course, do much, but they will be more successful if the ground has been prepared. Carried throughout, the recommendations would lead to an ecologically sounder but very different way of life. Convincing presentation of conservation values through the formal system of education is liable to be offset by large and impersonal administrations, paternalistically operating relatively inflexible programmes in monotonous surroundings, for young people who see their futures affording little opportunity to work, to think for themselves to do anything but conform to a limited life-style, or explode ineffectively in rebellion against it. If this has a "familiar ring" to it let us be warned. Progress in education will have to be part of a wider progressive change in the system which it serves. It will reflect the values of that system even while striving to re-shape them for the future.

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APPENDIX 1

A Prospectus for Environmental Course Content from a Biologist's point of view (adapteded from Smyth 1980)

N.B. The list if not intended to be complete, but only an illustration of something which will vary according to circumstances.

Main Ideas	Possible study material	Important Issues to which they refer
Everything is interdependent with everything else.	Any situation involving relationships - a room, a meal, a derelict site, a pet, a plant, a committee.	Association of elements into systems; analysis of systems into components.
Water, air, minerals are vital for life.	Weather recording, water use, water quality, air quality, air movement, air consumption, soil studies, plant growth, fertilizers.	Circulation of matter.
The sun is the source of energy.	Light and temperature recording; plants in light and shade; day and night rhythms; energy storage; energy consumption; fossil fuels.	Energy flow; balance between input and output.
Plants are a necessary part of our world.	Gardens, parks, playing fields, agriculture, forestry: uses of plants; plants and climate; microclimates; plants and landscape.	Role of plants, especially as primary producers; basis of food pyramid.
Animals are a necessary part of our world.	Animals in variety - zoos, farms, wildlife parks and reserves; uses of animals by man; pests and controllers of pests; animal groups and societies.	Role of animals: trophic levels: behaviour: mutualism.
Micro-organisms are a necessary part of our world.	Biodegradation in soil, composts, food, timber; commensals, parasites, pathogens; public health, sewage disposal; fermentation.	Role of decomposers and parasites in ecological systems.

Environmental factors limit and affect the numbers of organisms.	Comparisons of different sites in terms of plant, animal, human populations; effects of change, limits to growth - goods, homes, work.	Population size and the quality of life.
Environmental factors affect development.	Life histories of familiar organisms - effects of varying conditions on growth; external influences in pregnancy.	Unity throughout life of the individual.
Environmental perception varies.	Different sensory inputs; instrumentation; codification of data; interpretation.	Selectivity of perception and of responses.
Man can change the environment quickly and considerably.	Effects of building developments on plant, animal, human, communities; effects of pollution incidents; rapid exploitation of resources; derelict sites - historical studies.	Constrasting rates of change and adaptation between natural and man-induced developments.
Wasts, natural and man-made, can become pollutants.	Organic waste accumulation and oxygen deficiency; mineral wastes; atmospheric, domestic, industrial discharges; litter.	Effects of stress on systems.
Man can control environmental change.	Management of gardens, farms, water resources, nature reserves, power supplies, sewage discharge; recycling wastes.	Planned control of dynamic systems; prediction of effects of change.
Short-term gains can mean long-term losses.	Overcropping and soil quality; over-grazing and soil erosion; over-fishing and the fishing industry; over-eating and health. Endangered species, third world exploitation.	Degradation and irreversible change, and succession.
Natural resources may be conserved by developing alternatives.	Alternative fuel supplies, alternative food sources; alternative choice of activity.	Evaluation of natural resource use.
Unequal division of natural resources affects conditions of life and land use.	Patterns of land use, e.g. in farming, associated with soil, drainage, etc. Different power sources - coal, oil, hydro-electric.	Planning the best use of natural resources.

Higher incomes lead to changes in land use.	Separation of amenity and industrial land; Urban regeneration. East End - West End; luxury crops.	Evaluation of change.
Transport affect distribution of population and land use.	Effects of transport on movement of people, goods, live-stock, weeds, pests, diseases.	Effects of increased movement on spatial heterogeneity; effects of mixing and competition.
Increased leisure affects population distribution and land use.	Recreational pressures on land and wildlife; seasonal movements of population; constructive uses of leisure.	Evaluation of human activities and aspirations in relation to resources.
Social and cultural values affect attitudes to environment.	Values of different land users compared; farmer and forester, beach party and mountaineer, business commuter and football crowd.	Benefits and problems of human heterogeneity.
Economic and political factors.	Varying costs of services and goods; varying levels of unemployment; 'green' movements; customs and laws.	Complexities of the human system related to environmental systems.
Individuals should respect life.	Accidents, destructiveness, racial disharmony; self-control; aesthetics; ethics.	The environmental conscience.

THE STATUS AND RELEVANCE OF ENVIRONMENTAL EDUCATION IN INDIA

by
S. Srinivasan

and
D. K. Banerjee

ABSTRACT: Environmental education assumes special relevance in developing countries like India where the environmental related issues and problems are of a qualitatively different nature than those in the developed countries. They arise more out of inadequate development rather industrialization. Environmental awareness and education programmes in India are run on formal and non-formal levels. In a country burdened with overpopulation, poverty and low literacy, these programmes can bank more on the non-formal approach. Many voluntary and non-governmental organizations are active in this direction. There have been significant changes in curricula at the formal levels also. Inputs of environmental studies have now been incorporated in curricula right from the primary level. These efforts have resulted in perceptible development of environmental awareness among people. Nevertheless, there are still many constraints in implementing environmental education programmes and they have to be overcome.

Introduction

The need for environmental consciousness is indisputable throughout the world, especially in developing countries. Environmental problems assume unique proportions in a country like India; over population, acute poverty and a low literacy rate are complicated by gross ignorance of the environmental deterioration caused by human activities. One way of minimizing environmental problems is comprehensive environmental education at the grass root level.

Environmental Problems in India

In India inadequate development, not industrialization, causes environmental problems. Solutions to these problems must first consider the root causes - social, economic and cultural factors such as population, poverty and illiteracy. India's population now stands at some 684 million (1981 census); it is expected to increase at the rate of about 2% per annum. Natural resources will be increasingly exploited and the accompanying environmental problems will multiply as population and poverty levels rise.

Poverty is the principal cause of a continuous desperate destruction of India's natural resources. Like many part of the developing world, per capita income and food availability are very low in India. With such widespread poverty, vast communities are compelled to live in a manner destructive to valuable soils, water resources and vegetation cover - all of which are crucially important to life itself. High population and poverty levels contribute to a situation where sanitary facilities are minimal. Only eight of the more than 3000 cities and towns in India have complete sewage facilities (Central Pollution Control Board, 1979 & 1980).

With increased population, migration from rural to urban areas is much more rapid than anticipated. The urban population - 23.73% of the total population - grew by 48% from 1971 to 1981, while the rural population increased only 18.96% (Srinivasan and Banerjee, 1983). The creation of new urban settlements, and the extension of the existing settlements so as to accommodate the increasing population, has taken place without a corresponding increase in the supply of public utilities, resulting in serious environmental problems. In urban areas, people use water bodies as conduits for dumping wastes: in Bombay the Ulhas and Kalu rivers, in Delhi, the river Yamuna; in Calcutta, the river Hooghly and in Madras, the river Cooum and the Buckingham canal. Refuse invariably mixes with open water resources, leading to water-borne diseases. 76.3% of India's population lives in 567,000 rural villages. Two hundred thousand of these villages, with a population of 160 million are yet to be provided with potable water supplies; 98% of the rural masses do not have latrines (Central Pollution Control Board, 1980). In one-third of the 40 million households, human excreta is still collected manually and unhygiencally disposed of, polluting water sources and food. 7 million households use open ground for defecation. This breeds hookworms and other parasites. It is estimated that in all, 70% of the available water in India is polluted with two-thirds of all reported illness caused by water-borne diseases like hepatitis and typhoid (Sunderasa, 1981).

Increased population and poverty also contribute to forest destruction and soil erosion. Only 11-12% of India's total land cover is forested, as opposed to the national objective of 33%. In the last 30 years, it has been estimated that 4.5 million hectares of forests have been vandalized but only 2 million hectares have been reforested (Ministry of Agriculture, 1983). India's rich heritage of flora and fauna is fast disappearing as forests are becoming bare and decimated. Environmental problems such as soil erosion, flooding, water logging and salinity are evident in 175 million hectares of land, out of a total land area of 304 million hectares (Ministry of Agriculture, 1983).

Literacy is quite low in India. Nearly one-half of the male and three-fourths of the female population are illiterate (National Institute of Education Planning and Administration, 1983). The education system is bedeviled by poor enrollment levels and high dropout rates. In such a situation, there is ignorance and lack of understanding about environmental problems, although a plethora of environmental laws are in force. At present in India, nearly two hundred national and state laws have a direct bearing on environmental protection (Davider, 1982). Two major anti-pollution laws are the 1974 Water (Prevention and Control of Pollution) Act and the 1981 Air (Prevention and Control of Pollution) Act. However, most of the laws are either obsolete, have too many loopholes or do not clearly state their cbjectives. The public is also generally unaware of the various legislations which have been formulated to protect the environment. There is no procedure for reviewing the efficacy of these laws. Regulatory law enforcement is a long-drawn legal affair; by and large these laws are more ineffective than successful.

Environmental Education Programmes In India

An urgent need exists to inform and educate the population if the above problems are to minimized. Though environmental education is a difficult task when a considerable percentage of the general public is poor and illiterate, education is still the most powerful tool to engender an awareness and consequent improvement of the environmental situation.

The existing environmental education programmes in India can be broadly divided into two categories: (a) formal and (b) non-formal.

Formal environmental education

(1) At primary and secondary (school) levels

Education programmes for children should primarily aim at the gradual cultivation of environmental awareness and development of positive attitudes towards preservation and conservation of the environment. Environmental education curricula and textbooks are developed by the National Council of Educational Research and Training (NCERT) of the Ministry of Education, Government of India. The NCERT programmes cater primarily to the needs of school children in the 6-18 year old age group, i.e., Primary to Higher Secondary levels. School curricula designed by NCERT centers on the local environment for lower classes. In advanced grades, interrelated local principles and global environmental issues are stressed (NCERT, 1981a). Some of the effective environmental awareness programmes involve maintenance of school gardens, lessons in practical hygiene and extra curricular activities such as essay competitions and exhibitions. Since 1982, the United Schools Organization of India (USO) has collaborated with the Department of Environment (DOE) and increased environmental awareness among school students by sponsoring yearly All-India essay competition on environmental issues (USO, 1984). A variety of teaching-learning materials are also prepared by the Department of Teaching Aids, NCERT, for school going children and are now widely used in schools (NCERT, 1981b). Other organizations like Vikram Sarabhai Community Science Center and Center for Environmental Education at Ahmedabad are also active in this field.

Environmental education curricula must include more than text books. Children are fascinated by the natural environment and outdoor activities should be emphasized. Excursions or trips to historical places, museums, sanctuaries, national parks, zoos, forests and river sites can be valuable. Indian schools have not yet fully utilized this concept. With proper planning, the individual, discipline-oriented studies can better correlate with the children's immediate environment.

(2) At tertiary (university/college level)

In India, there are presently 149 universities (including 21 agricultural universities, 10 institutes of national importance and 15 autonomous institutes deemed to be universities) and 5040 colleges. 3.1 million students are seeking postgraduate and research degrees and diplomas (Association of Indian Universities, 1984). Only a few universities and colleges include courses in environmental chemistry, environmental biology, ecology, environmental microbiology or environmental engineering. Those courses that do exist are single discipline oriented courses and do not utilize an interdisciplinary approach to environmental studies. Many university administrators and some teaching staff believe the environmental sciences do not constitute a 'true discipline' and, therefore, do not deserve full academic status. Moreover, job-advertisements in India ask for minimum basic qualifications in demarcated disciplines; degrees in interdisciplinary courses are not asked for or encouraged. To solve these problems, the academic mentality must change and a system of rewards, not necessarily financial, should be established to make environmental studies courses more attractive and job-oriented.

The National Environment Engineering Research Institute (NEERI) provides opportunities for research and development in environmental engineering sciences. Other funding agencies such as the University Grants Commission (UGC) and the Department of Science and Technology (DST) have started granting funds for carrying out research projects in areas of environmental sciences. Still, research in many Indian universities remains mainly academic and seldom leads to solutions of real life problems relevant to our own environmental situations and local needs. Many universities and colleges have started devoting some attention to environment oriented extracurricular activities through the National Service Scheme and National Cadet Corps. Of late the UGC is producing higher level educational programmes for television. These programmes initially benefit 800 colleges (Audience Research Unit, 1984) and will ultimately be available in various Indian languages throughout the country. This medium can be fruitfully utilized for environmental education.

(3) Teacher Training

Teacher training at all levels must receive top priority. Properly trained teachers play a significant role in creating awareness within the younger generation about environmental problems.

The interdisciplinary nature of environmental education poses many problems in India. Most teachers are conversant and trained in the watertight compartments of a single discipline; they find it difficult to deal with an actual environmental problem or issue. Therefore, training programmes should be introduced for both preservice (for those who are beginning their teaching careers) and in-service (for those who are already on the job) teachers.

In the pre-service programme, environmental education should be incorporated into the teachers training as it has been done in NCERT's Regional College of Education (NCERT, 1981b) and some other state colleges/institutions of education. The in-service training is also very important, the teachers require reorientation of their beliefs and attitudes toward environmental problems and many situations may require new methods of thinking and action. In-service environmental education programmes for the teachers could include seminars, workshops and short training courses, through correspondence-cum-contact programmes, teachers training institutes/university departments or through mass media. Such methods are already in use and becoming quite popular. The United Schools Organization of India, in collaboration with the DOE, organizes national seminars/workshops on environmental education every year at different parts of the country for in-service school teachers (USO, 1983) and a few Indian Universities offer correspondence courses leading to B. Ed. and M. Ed. degrees for in-service teachers. Suitable inputs of environmental studies can be incorporated in these courses.

(4) Training other personnel

Professionals, executives, planners and administrators should also be well informed on environmental problems. Programmes in environmental management can be introduced to them during their pre- as well as in-service training. For example, the Administrative Staff College of India, Hyderabad, has organized a National Workshop on Environmental Management every year since 1978 for planners, executives, administrators and officials concerned with environmental planning and management. Also, institutes like the Indian Institute of Management and the Indian Institute of Public Administration are playing a significant role in this regard by holding similar workshops on various aspects of environmental planning and management from time to time. The DOE has proposed (DOE, 1982-83) setting up a National Institute of Environmental Management to address environmental problems in their totality. One centre in India well known for training environmental professionals and scientists is the National Environmental Engineering Research Institute. Only one university in India, viz., Jawaharlal Nehru University offers a package of interdisciplinary courses on environmental sciences at the post-Master's level.

Non-formal environmental education

The majority of global environmental education programmes are based on formal teaching and learning. However, non-formal education especially important in a country like India where literacy levels are low.

(1) Out-of-school children

In India approximately 100,000 non-formal education centres for 9-14 years olds exist with an enrollment of 300,000 children (Nonformal Education Group, 1984). In these, regimentation and rigidities relating to time, place and duration have been removed. In order to provide education to out of school of this age, NCERT developed a curriculum highlighting local environmental problems and practices. Forestry, animal husbandry, waste recycling, sanitation and personal hygiene are included in the teacher's guide and the primers for rural, tribal and urban children.

New Delhi's Central Board of Secondary Education, uses a programme called 'Open School' designed for drop-outs, working adults, housewives and disadvantaged sections of society. It provides education at home through "distance teaching" methods. Environmental studies are included in curricula through natural, physical and social science.

(2) Adult education

Adult education and literacy should take a front place in any programme for economic and social development. The programme should not only emphasize acquisition of literacy skills but should try to communicate important messages which have a bearing on the peoples' life. The needs and problems of rural and urban areas are different and therefore, while planning any environmental programme we address the target groups. Local problems should be emphasized in the adult education programme.

At the present in India we have 162,922 adult education centres with an enrollment of 4,753,012 adults. More than 90% of our centres are in rural areas (Directorate of Adult Education, 1983). The literacy materials in adult education programmes in India include health, hygiene, social obligations of a citizen and interrelations of water, air, earth, trees, plants and animals with men. A large number of voluntary agencies, colleges, universities and state governments implement this programme.

(3) Role of Mass Media

Since the literacy rate is low in many developing countries, ways and means of spreading environmental education programmes to the ordinary citizen must be devised. Mass media-radio, television and press - are quite effective because of their flexibility and wide audience.

Environmental education programmes transmitted by radio are of outstanding importance for developing countries. In India transistor radio sets are now quite common and, in remote rural areas, often represent the only means of quick communication with the outer world. At present, India has radio stations broadcasting to 90% of the total population. On the average, 33% of our total programmes are educational (All India Radio, 1983). India now has a massive TV expansion underway. By January 1985, 180 transmitters will broadcast to 70% of our total population. Presently 30% of our TV programmes are designed to educate and create awareness among the general public (Audience Research Unit, 1984).

"Going to the movies" is the major form of entertainment in many developing countries and is particularly popular among the rural population of India. An average weekly audience of 70 million people means many people could be reached by short feature films on environmental subjects (Ministry of Information and Broadcasting, 1983). Good documentary and feature films on environment have become an important medium for environmental education. Actual case studies emphasize the fact that these problems actually exist and are not theoretical. Government of India presently produces a number of documentary films through its Films Division every year; some of them are devoted to environmental themes. World Wildlife Fund India and DOE have also produced films exclusively on environmental problems and case studies.

The press in India with its several thousand newspapers in English and Indian languages, could play a more important role in communicating environmental awareness. It's effectiveness is limited, however, as readership is well below 10% of the total population (Ministry of Information and Broadcasting, 1983). The role of Indian newspapers in fostering mass interest on crucial environmental issues is also limited because the masses, stricken with a basic lack of food, clothing and shelter, often consider environmental issues a low priority.

Displays and large exhibits play an important role in disseminating information. For villagers the use of folk and traditional media such as street plays offers a variety of opportunities to raise environmental awareness. Many voluntary and non-governmental organizations (NGO's) in India are doing excellent work in this area. Their innovations and experiments have evoked good response. The largest such group in the country is the Kerala Sastra Sahitya Parishad (KSSP) in the southern state of Kerala. It is now more than 20 years old and has about 10,000 members who campaign among people through skits, songs, street plays, folk arts and literature.

Thus, proper utilizations of multi-media for educational purposes would help create wide-spread environmental awareness and understanding.

(4) Role of Governmental Organizations

During 1980-85, the Government of India earmarked some 400 million rupess for various environmental programmes and organizations. Out of this, 50 million rupees were allotted to environmental education and training programmes (Agarwal et. al., 1982).

To promote environmental education, training and awareness ar various levels, the DOE initiated several activities that addressed specific target groups - decision makers, planners, administrators, educators, students and people in general. Some of these activities include: nonformal education through seminars, workshops, refresher courses, group discussions, popular lectures, multi-media campaigns, posters and essay competition etc; nation-wide celebration of the World Environment Day and Wild Life Week; and organizations and universities to create environmental awareness and induce public participation in the solution of environmental problems (DOE, 1983).

Very recently, the DOE has set up a Centre for Environmental Education at Ahmedabad. Its main functions are producing educational materials including audio visual aids, training teachers in environmental education, providing assistance to other institutions in the area of environmental education, conducting education programmes/seminars/workshops at national/regional levels, developing documentation for a data centre and setting up a natural history museum (DOE, 1984).

DOE maintains a National Museum of Natural History at New Delhi, which provides environmental education opportunities to all sections of the society. Its diverse educational programmes provide a scientific outlook towards and understanding of natural sciences and environmental factors. Some of their innovative programmes like creative activity for children, mobile museum and 'touch-see-learn' programme for the blind receive very good responses from their audience.

So far, 12 out of 22 states in India and one Union Territory out of 7, have set up Departments of Environment according to the advice of the Central Government (DOE, 1984). These Departments also play a big role in creating environmental awareness among the public at large through different environmental education programmes.

(5) Role of Non-Governmental Organizations

The task of tackling environmental problems require concerted efforts not only by the Government but also by the people at large. People's support for environmental causes can be catalyzed through NGO's, which are in the best position to coordinate and encourage the public awareness, motivation and commitment necessary for successful action in the multidisciplinary, all pervasive area of activity of environment.

NGO's have been very effective in developing countries. India fortunately has many NGO's (or voluntary agencies) actively engaged in various environmental issues. As per the Directory of Non-Governmental Organizations in Environment, 129 of these NGO's are concerned with environmental education and awareness. Mostly they are city based (Environmental Information Systems, 1984).

NGO's have been supported by the DOE not only for undertaking educational awareness programmes through seminars, symposia and workshops, but also for action-oriented field schemes, under the eco-development programme, which involve public participation in the solution of environmental problems (DOE, 1984)

CONCLUSION

Environmental problems in developing countries, particularly India, are of a qualitatively different nature than those in developed countries. Ignorance tops the list of many factors contributing to these problems. No amount of government legislation and action can lead to any improvement or change in the situation unless an effort is made to increase public awareness of the environmental problems. In order to generate environmental awareness, environmental education should be a part of the formal school and college curricula. To reach those who are outside of the educational systems, mass media should be extensively used and programmes for out-of-school children and adults must be focused so as to generate public awareness on environmental issues. The NGO's can play a significant role in this direction. Some of the major constraints in implementing environmental education programmes are inadequacies of trained personnel, programmes relevant to the needs of different groups of learners, materials emphasizing local environmental problems and possibly written in local languages, inexpensive teaching aids and last but not the least, financial resources. These are more often than not coupled with bureaucratic apathy at large towards matters related to environment.

Thus, environmental education at all levels has to be strengthened in order to develop awareness and understanding of environmental problems, in developing countries like India.

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A EUROPEAN EXPERIMENT IN ENVIRONMENTAL EDUCATION

by

Anton Trant

ABSTRACT: The European Community has an action plan for the environment, which was first formulated over ten years ago. Within the context of this plan the Community has developed a small network of pilot schools in environmental education with the dual purpose of mutual cooperation and learning from each other's experience, and spreading their ideas to other schools in Europe. The activities of the network have been teacher and pupil exchange visits, project work on agreed themes, teacher seminars, production of materials, publication of a newsletter and the creation of local, regional and national dissemination initiatives. So far the Network has had a primary and a secondary phase. A third phase is now being planned which will take account of the need to relate environmental education to the major socio-economic problems which the Community is now experiencing. The ultimate aim of the network is to make some contribution, however small, towards realizing the ideals of European unity.

European Community's Environmental Policy

The European Community is generally associated with trade and economic policies. The Community's environmental policy is less widely know, despite the fact that it is now entering its second decade. The European Community was in fact among the first international organizations to respond to the United Nations Conference on the Human Environment in Stockholm in 1972 when a plea was made for global action on the environmental crisis. Concern for the environment, however, is not something new in the European Community. It goes back, in fact, as far as 1957, to the Treaty of Rome and could be said to be an essential part of the fundamental philosophy which brought the Community into being. At the Treaty of Rome the member states declared that economic growth was not their only objective; they were also concerned with the standard and quality of living of all their people. Keeping the balance between economic growth expansion and the quality of life was emphasized again at a summit conference of the European Community in Paris in 1972. This meeting was to act as the forerunner to the Community's subsequent Action Programme for the Environment. In calling for such a programme the leaders of the Community declared:

> It should result in the improvement in the quality of life as well as in standards of

> living. As befits the genius of Europe, particular attention should be given to intangible values and to protecting the environment so that progress may really be put at the service of mankind. (Commission of the European Communities, 1976).

It was in this way that the Community's Action Programme for the Environment came into being. It was first formally adopted by the Council of Ministers on 22 November 1973 and later renewed and supplemented in 1977 and 1983. Underlying the programme it is possible to detect two major principles. The first is that man's relationship to the planet and its resources should be characterized by husbandry and good management rather than unthinking exploitation. Environmental policy is therefore not a gloss added to production and consumption but an effort both to understand respect the planet which sustains us and to develop a right relationship with it. In times of recession and shortage it is all the more necessary to do this since the short-term wisdom of profit-and-loss economics does not itself ensure the best use of resources to meet social needs.

The second principle is that environmental policy should be designed to increase human welfare by improving living and working conditions. Thus while it is important to be concerned with reducing the negative consequences of production, consumption and urbanization, and with preventative measures to safeguard the future, the ultimate concern should be to create the best conditions in which individuals, families, groups and whole societies can flourish.

Educational Implications

Although the Community's Action Programme for the Environment is not chiefly concerned with specific educational measures, it does have an overall educational significance. A basic assumption underlying the entire Programme is that concern for the environment is the duty of everyone in the Community and that public opinion should therefore be educated to be more aware of the fact. This point was emphasized in the first chapter of the original Programme:

> At all levels continuous and detailed educational activity should take place so that every person in the Community becomes aware of the environmental problem and fully assumes his responsibilities towards the generations to come. (Commission of European Communities, 1977)

The second version of the Action Programme which was adopted in 1977 contained a more specific educational recommendation - one that was to assume increasing importance in the years that followed. The intention was announced of launching a network of pilot schools across Europe to exchange ideas and experiences in environmental education, and to disseminate these ideas to a wider audience. This plan had been under consideration for the previous three years in the Community's executive - the Commission of the European Communities. Before launching it, however, the Commission decided to test its acceptability by undertaking a feasibility study.

The need for the feasibility study primarily arose from the ambiguity that surrounded the term 'environmental education' in the member states of the European Community. There was considerable diversity between and within the various national educational systems in the way in which the objectives and content of environmental education were defined, and the way in which it was organized whether as an integrated component of the curriculum in its own right, or as a number of separate components within traditional subject disciplines.

The purpose of the feasibility study was envisaged as being twofold. The first element would be largely descriptive in that examples of outstanding practice at upper primary and lower secondary levels (age group 9/14 years) would be selected from all the member states and presented as case studies. The second element of the study would be concerned with the acceptability of the network idea. A range of contacts would be made with key people working in the field of environmental education in the member states. Guidelines would be put forward for future network activities, such as establishing links between schools in different countries, animating exchange programmes and study visits for teachers and pupils, and producing resource materials in environmental education, both for direct use by pupils, and producing resource materials in environmental education, both for direct use by pupils, and as background information for teachers. In this context the study was envisaged as a preparatory phase in the establishment of the network itself.

A report on the feasibility study was presented to the Commission in April 1976 (Trant, 1978). The report noted that it was difficult to define in precise terms environmental education in the member states of the European Community; it was not a subject like history or mathematics but was more like an ideal or general aspiration. Nevertheless there were certain similarities in the efforts of the different member states to develop patterns of environmental education. Within the age group 9/14 years the following common trends were identified: a realization at primary level that active and child-centred learning was readily realizable through a study of the environment; an effort in the lower years of secondary schooling to integrate different subjects along environmental themes; an effort to link the school with environmental facilities, such as museums, zoos, and botanical gardens; a growing number of research and development projects in environmental education; a realization of the potential for environmental education in such traditional activities as field studies and outdoor pursuits; an emphasis on the role of urban studies as an essential element of environmental education; and a growing awareness of the importance of voluntary organizations, clubs and action groups which offered young people an opportunity of involving themselves directly with their own environment.

One of the main purposes of the feasibility study was to establish contact with interested officials in the ministries of the member states. The report stated that in all cases there was agreement in principle to cooperate in the development of a network of schools in environmental education for the age group 9/14 years, and it added a two-fold justification for developing such a network. There was first of all the need for an interaction at Community level to help integrate an environmental dimension into school curriculum; most of the ministry officials who were consulted were in favor of such an initiative and were awaiting an official notification of the Commission's intentions. Secondly, the proposed network would be an example of European cooperation in a practical and meaningful way. If the Community's ultimate aim was to a lay the basis for an united Europe then a joint undertaking in environmental education by all the member states would be a small but important step in that direction.

Structure of Network

After nearly three years preparation the European Community Environmental Education Network eventually came into being in February 1977. The basic idea was simple: to enable a chosen group of pilot schools to enter into meaningful contact with each other. With this end in view the Network was given two principal aims. The first was to enhance the quality of environmental education in the pilot schools through mutual cooperation and learning from each others experience. The second was to collect, test and disseminate environmental education materials.

The first aim denoted the dynamic nature of the Network. It was assumed that the pilot schools would be chosen not only because they had a record of good practice in environmental education but also because they were willing to share with and learn from schools from other parts of Europe. In this way it was hoped a rich and varied picture would emerge of how environmental education was taught in a whole range of different cultural and geographical surroundings. Furthermore, the potential for comparative studies would be exciting since the Network would include a series of contrasting environments - the urban and the rural, the coastal and the inland, the mountainous and the lowland, and the industrial and the agricultural.

The second aim had a seminal implication. The Network would exist not only for the sake of the pilot schools but for other schools and institutions. It would have a responsibility to preach the gospel of environmental education in the highways and byways of Europe and to seek to influence not only the educational systems but the general public as well. It was primarily expected to do this through the dissemination of environmental materials. This brief, however, was to be interpreted widely; the materials could be audio-visual as well as print and the vehicles of transmission could include press, radio, and television as well as the more traditional journals and hand-books.

When it came to a consideration of term 'environmental education' the Network adopted a pragmatic approach. It did not seek to define in exact terms the meaning of environmental education; that was considered to be the prerogative of each member state. The Network, however, offered a simple and practical guideline, which it was hoped would help to produce case-studies of environmental education in action. Simply stated this meant that in the development of project work it was envisaged that environmental education would be interpreted broadly, as taking into account the different cultural backgrounds of the pupils and involving disciplines of both the social and natural sciences.

The responsibility of coordinating the activities of the Network was entrusted by the Commission to a coordinating team at the CUrriculum Development Unit, Dublin. The Curriculum Development Unit was established in 1972 by the City of Dublin Vocational Education Committee (CDVEC) and is managed jointly by the CDVEC, Trinity College, Dublin and the Irish Department (Ministry) for Education. The coordinating team keeps in contact with all members of the Network and facilitates the inter-communication which is necessary for the dynamic development of the project. An Advisory committee, composed of officials from the Commission of the European Communities, representatives from the member states (national experts) and members of the coordinating team, is responsible for overseeing the progress of the Network and advising on all policy matters. The national experts also play a vital role in their own countries in supporting the activities of the pilot schools.

The Network so far has had two phases - primary and secondary. The primary phase comprising 29 pilot schools lasted from 1977 to 1982 and catered for pupils in the age range 9/11 years (later extended upwards in some member states to 14 years and downwards in others to 4 years). The secondary phase which comprises 28 pilot schools and caters mainly for the age range 12/16 years, began in 1982 and is scheduled to finish in 1986.

Activities of Network

In June 1977, at a general seminar in Dublin the teachers of the Network met each other for the first time. They agreed to engage in a number of activities for a period of twelve months, and then to come together again for another general seminar, at which they would review their progress. This democratic procedure has been followed in the eight years of the Network's existence and the activities engaged in have been as follows: teacher and pupil exchange visits; project work on agreed themes; teacher seminars; production of materials; publication of a newsletter; and the creation of local, regional and national dissemination initiatives.

From the outset the practice of teachers and pupils visiting each others schools was given priority. These visits emphasized in a very practical manner the European dimension of the Network. Although the various schools belonged to very different systems of education the environmental problems which the teachers and pupils were studying were remarkably similar. The study of the environment, in fact, proved to be an important unifying theme throughout the European Community. It transcended linguistic and political boundaries and gave teachers and pupils an awareness of their common European heritage.

Each year the pilot schools agreed to work on broad themes related to the environment, such as energy, recreation and water. This project work was usually characterized by great enthusiasm and spontaneity, and often led to participation in a wide range of ancillary activities such as exhibitions and competitions. Sometimes, too, the project work culminated in some form of active or practical scheme to improve the local environment. Usually the project work attracted the notice of the local, or national, media.

Three kinds of seminars took place in the Network - general, group and inservice seminars. The general seminars were annual events during which the previous year's work was reviewed and plans were made for the following year. The group seminars were working sessions for particular groups of teachers who had chosen to work together on a agreed theme. The inservice seminars were planned in conjunction with an institution or a national or regional authority that had a particular expertise in some area of environmental education.

The production of all kinds of materials, print and audio-visual, was a natural outcome of the project work in the pilot schools. Much of this material related to some aspect of the local area, which was seen to have many possibilities for environmental education. As a theme the local area had an immediate and concrete appeal and yet was wide enough to allow for a variety of approaches. For the Network schools, local area studies had the added attraction of offering a range of contrast studies across Europe, and thus yielded many valuable insights into the various European traditions. Some of the Network materials transcended local interests and have been produced by groups of schools working together for periods of one to two years, on themes such as water, energy, air, urban studies, recreation and cultural heritage. These materials have been published by the Coordinating Team in several languages and disseminated throughout the Community.

The Network also publishes a bulletin, Milieu, twice yearly in Danish, Dutch, English, French, German and Italian. The bulletin contains reports on the work of the pilot schools and articles on various aspects of environmental education at local, regional, national and international levels.

In all member states the Network has been instrumental in helping to create dissemination initiatives in environmental education. In some member states this has taken the form of local, regional and national networks of schools. In other states the Network has been used as a basis for teacher inservice courses or has acted as a stimulus for policy documents, newsletters, films and video tapes.

Evaluation

So far there have been two formal evaluations of the Network, both carried out by the Coordinating Team and both relying on questionnaires and interviews in the one case with the national experts, in the other with the teachers in the pilot schools. The following issues were dealt with in the evaluation reports: aims of environmental education, its place in the curriculum, reasons for teaching it, the disciplines underlying it, methods of teaching it, learning outcomes, and reactions to it from pupils, parents and the public at large. Limited space permits only a few comments on some of these issues.

It is interesting to note that the definition of environmental education which found general acceptance in the Network was the IUCN definition- or some modification of it (IUCN 1970). Furthermore, in all the member states the aims of environmental education came within the ambit of general education, but added a specific environmental dimension - the interrelationship between man, culture and the biophysical surroundings. This suggests three aspects which should form part of any worthwhile programme in environmental education: (i) learning about the environment through knowledge, concept and skill objectives, (ii) learning for the environment through attitudinal and value objectives, (iii) decision making and action based on the acquisition of both these kinds of objectives.

Decision making and action as integral parts of environmental education were given different emphases by different working groups in the Network. One group was quite explicit: environmental education essentially means to observe, to understand and to act. The kind of action envisaged could be termed social action: the pupils could become involved in various forms of community development such as restoring a local recreational area or establishing a market in a town centre. Other groups felt that the action undertaken need not always be in social context but could take the form of an activity such as art, craft, drama and dance.

The question of how far a school should be engaged in environmental action is a complex one and is perhaps best answered through individual case studies of what particular schools have attempted to achieve. Circumstances vary considerably between different schools. Several important factors have to be considered: the age of the pupils, the relationship between the school and the local authorities, the views of parents, and the social context of the teacher's role - to mention but a few. There are undoubtedly great attractions in the idea of action-oriented education. Schools appear to be much more relevant places when they involve themselves with the great world outside their doors. There are also great dangers. The world of action is a place where people must be prepared to pay for their mistakes. Schools on the other hand, should be places where young people can experiment and be given freedom to make mistakes on occasion.

The underlying disciplines of environmental education featured prominently in the evaluation reports. Many commentators today state that environmental education should not form a new curricular discipline but should rather be put into practice through a partnership among existing disciplines - it should in fact be an interdisciplinary activity. This at least is the theory: the practice, however, is far from simple. The experience of the Network leads us to draw a distinction between the different age groups of pupils involved. With the younger age groups up to about 12 years, a teaching methodology which integrates the various disciplines is possible and even desirable. This approach is in line with the general curricular guidelines for primary education which can be found throughout the European Community - a child-centred, activity-based approach which regards the environment as an effective way of integrating the entire curriculum by relating it to the boundless curiosity which children have for the world about them. At this level, spontaneity, enthusiasm and participation are all characteristics of the pupil's activities, and attitudes and environmental sensitivity tend to be stressed more than knowledge and cognitive skills.

Among the older age groups, the interdisciplinary ideal is confronted with several difficulties. These difficulties are inherent in the traditional structure of post-primary education, which tends to be subject-centred, examination-oriented and constricted by the exigencies of timetables. Under these conditions it is not easy to achieve interdisciplinary teaching especially across the entire curriculum. The difficulty involved is not merely one of the epistemology, of how knowledge should be divided; there is also a psychological difficulty arising from the dynamics of grouping - how to persuade teachers of different temperaments and background to work satisfactorily together.

Interdisciplinary teaching, however, in the upper age groups is not an impossibility and there are many examples in the Network schools of successful interdisciplinary experiments. The usual approach is for a school to select a theme that is both immediate in its appeal and broad in its scope - such as the local river, a local park or some aspect of schooling, work or recreation. Next a team of teachers from different disciplines - often a very wide range indeed - agree to pursue the chosen theme over a set period of time, usually a school term. The methodology involves much planning and field work and the project more often than not ends with a display to which parents, various dignitaries and the general public are invited.

Dissemination

The task of dissemination is to ensure that an innovation has a lasting effect on the general system of education. Successful dissemination is difficult to achieve as is evident from the fact that over the last two decades educational innovations have had far less effect than was originally hoped for. Therefore, an important preoccupation among educationalists today is the study of dissemination - the attempt to understand the difficulties of how new ideas and approaches take root in the general system. In the field of environmental education the European Network has a contribution to make to the task and study of dissemination and in this context two observations may be made.

The first observation may seem obvious but nonetheless needs to be stressed: dissemination like truth is the daughter of time. Today with our great preoccupation with change we tend to become impatient with any process that requires growth and maturation over a period of years. In education, particularly, where many of the basic metaphors used are taken from this same process of growth, it is important to realize that worthwhile results can never be achieved overnight. The term dissemination itself implies a period of sowing and careful tending while the first tender shoots appear. This takes time. However, many of the typical curricular projects of today are conceived as three or four year spans with an expectation that at the end of that period there will be worthwhile results to be disseminated. We shall have to accustom ourselves to thinking in longer periods, of about ten years duration. This will have implications for the number of innovative projects that can be sustained, but the important thing is the will to sustain them.

The second observation is that teachers are central to the process of dissemination. In the past, strategies of dissemination have often been concerned with the implementation of innovations by teachers who generally had little or no part in the development of these innovations. Today, there is more emphasis on teachers playing a creative role, either as innovators themselves or else adapting and modifying innovations developed by others. Hence teachers should be seen not as the targets but the focus of the dissemination process.

The Network has always put the teachers in the centre of the stage. In the early years there were certain misgivings about this among the Network's sponsors. It was all very well to ensure that the Network experience was exciting and beneficial for the participants but what of other teachers and schools? How were they to benefit? It was only after about five years that the slow-growing pattern of the Network's influence could be detected. Teachers from the pilot schools moved to other schools or were promoted to positions of wider influence. Local and regional networks began to appear, built around one or two of the original pilot schools. Education officials at regional or national level began to see possibilities in the Network which fitted in with their own preoccupations. Policy guidelines which used the Network activities as examples began to appear and inservice seminars were organized. Finally, more attention was paid to the Network at ministerial level.

Obviously, there still remains a lot to be done. The Network bulletin 'Milieu' needs to be more widely distributed, more case studies and teacher hand-books based on the Network experience need to be published. The great amount of film and TV materials which have been made in the pilot schools needs to be edited and made more accessible. Finally, consideration will need to be given to continuing the Network in a third phase after 1986.

Future of the Network

At the beginning of the article we showed how the justification for the Network lies in the Community's Action Programme for Environment. The third edition of the Programme which was adopted in February 1983, takes a long term view of environmental action. Recognizing that the times are hard it none the less states categorically:

> environment policy is a structural policy which must be carried out without regard to the short-term fluctuations in cyclical conditions in order to prevent natural resources from being seriously despoiled and to ensure that future development potential is not sacrificed. (Commission of European Communities, 1983).

Indeed the Action Programme sees itself as contributing significantly towards a solution to the Community's major problems in the socio-economic sphere especially in creating new jobs through the development of key industries which ar either less polluting or use few non-renewable resources. As a recent Commission Publication expressed it: "ecology is nothing other than properly thought out long term economics". (Commission of European Communities, 1984).

It is in the framework of such thinking that proposal are now being made for the Network's third phase from 1986/1990. Just as the Third Action Programme highlights the importance of an environmental dimension in all the Community's social and economic planning, so also the Network environmental education dimension in all educational thinking and practice. The principal aims of the Network in its third phase will be therefore to assist the national and regional authorities throughout the European Community in their efforts to bring an environmental education dimension into all aspects of the curriculum.

It is likely that the new Network will focus on the age group 16 to 18 years - an age group which has been receiving increasing attention in all the member states of the European Community. This is the age group which bridges the gap between school and adult life and in which young people are preparing to make important choices regarding their future. This future, however, is far from certain or secure. Rapid technological and social changes have affected all the traditional patterns of employment. Young people face a complex and changing society which will demand of them considerable flexibility and readiness to adapt to new situations. Their education, therefore, needs to be correspondingly flexible, adaptable and open to new elements of knowledge and methods of learning.

Young peoples' opportunities for leisure, too are greatly enhanced. The great challenge, however, is to be able to convert these opportunities into creative activities which will foster development and maturity. Preparing young people for creative leisure pursuits may well become one of the most serious educational preoccupations of our age.

In the light of this thinking about the 16 to 18 year age group, it is pertinent to ask about the place of environmental education. Is environmental education seen to have any relevance in the new scheme of things? This will be a major question to which the Network's third phase will have to address itself. In a situation of such intensive review, the opportunities open to environmental education are exciting. Nonetheless, it will be necessary to demonstrate the vital importance of environmental education, and the fact that it has a real bearing on the opportunities and aspirations of young people today.

The future of the Network is in a certain sense bound up with the future of the European Community. The success of the Network will ultimately depend on the degree to which its participants can see beyond their national frontiers, and realize in some manner their essential unity as Europeans. This is an ambitious aspiration but one that is in line with what the European Community stands for. In this regard it is appropriate to let the Commission of the European Communities have the last word:

> In 25 years the European Community has gone through many crises but also recorded major successes. Education policy has not escaped the controversies. In the future, far more than at present, it will be necessary to view this policy within a broader framework, against the background of the fields in which the Community pursues an active policy and from which it will receive new stimuli. In this way it will have an opportunity to be more effective at the European level. (Commission of the European Communities, 1982).

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SECTION II

METHODS AND PERSPECTIVES ON EVALUATION OF CURRICULUM

PRECONCEPTIONS OF THE BIOSPHERE: THE CONCEPT OF EARTH HELD BY CHILDREN FROM ISRAEL, NEPAL, AND THE U.S.A.

by
Francis Fenderson

and

Terence J. Mills

ABSTRACT: Basic to understanding many environmental concepts is developing the notion of the earth as a finite body in space. Children form "earth notions" which include variations of the earth as a spherical body, surrounded by space, with gravity pulling things to the center. Studies of children from urban Israel, Nepal, and the U.S.A. identify five different levels of a developing "earth notion." In the study reported here, 91 rural Oklahoma, U.S.A. K, 2, 4, and 6th grade children were interviewed and notion level compared with various personal, home and school factors as well as the Israel, Nepal, U.S.A. data.

Children in the Oklahoma sample generally hold the same notion of earth as children from urban Israel, Nepal, and the U.S.A. The kindergarten children included a surprising number (20%) who had very definite level IV earth notions, while (26%) of the 6th graders possess the idea that we live inside a spherical earth (level II). Statistical analysis showed verbal ability, cognitive level, achievement scores, and sex to be the more reliable predictors of earth notion level. The findings of this study have implications for curriculum revision and improved instructional methods in environmental education.

INTRODUCTION

Joe Miller on Dimensions:

> If the earth were only a few feet in diameter, floating a few feet above a field somewhere, people would come from everywhere to marvel at it. People would marvel at its big pools of water, its little pools and the water flowing between the poles. They would marvel at the bumps and the holes and very thin layer of gas surrounding it. The ball would be the greatest wonder known, and people would come to pray to it, to be healed, to gain knowledge, to know beauty and to wonder how it could be. People would love

> it and defend it with their lives because they would somehow know that their lives could be nothing without it. If the earth were only a few feet in diameter.
>
> --Not Man Apart (Friends of the Earth)

What an experience it would be to step out into space and view the earth in this way, to visualize for the first time our planet as a whole. How sobering it must be to realize the earth's unique position in the solar system. How much more might we appreciate and value our relationship to the envelope of life and the planet it surrounds if we could take this viewpoint. Unfortunately, at present this experience is reserved for the select few who have traveled in space. Being earth bound, how does one develop a holistic view and appreciation of our planet?

Investigating children's understanding or "notion" of earth is the focus of the research presented here. From an educational standpoint, development of the earth notion has significance for instruction and curriculum development in the social sciences as well as the physical and biological sciences. The concepts of earth's shape, gravity and position in space are included in the study of geography, history, astronomy, physics, and ecology, to mention a few. Perhaps most important is the significance of the earth notion to concepts in the field of environmental education. Our earth is a finite body in space. Children around the world must grasp this idea before we can expect them to deal with the interdisciplinary aspects of environmental education and the necessity of international cooperation for conservation of resources and pollution control. The awakening of a sound environmental and conservation ethic may be predicated on the development of a notion of earth as a finite body in space.

Armed with the knowledge of how we develop our concept of earth, we may better apply our collective efforts to maintain and appreciate that which sustains us.

Purpose of the Study

The specific purpose of the research reported here is to replicate the interview procedures and two of the four psychological tasks from the Sneider and Pulos study investigating children's notions of earth (Sneider and Pulos, 1983, p. 205). In addition to replicating Sneider and Pulos' work, this study includes: (1) a rural U.S. population, (2) a comparison of rural U.S. children with children from urban areas in Nepal, Israel and the U.S.A., (3) an additional grade level (kindergarten) and (4) a home and school survey to identify possible sources of information related to the development of an earth concept.

The inclusion of data from children in rural U.S.A. and children in kindergarten, adds a broader perspective to existing data on children's notion of earth. Cultural (home and school) sources of information have also been suggested as contributing significantly to earth notion, and the survey used in this study will explore this question in greater depth.

The following questions guided the research:

1. What are the earth notions held by kindergarten, second, fourth, and sixth grad students from a rural Oklahoma community?
2. Is there a relationship between notion level and school grade level?
3. Is there a relationship between the earth notion level frequency for children of the same age in the rural Oklahoma, U.S.A. population and the group of children from urban centers in the U.S.A., Nepal and Israel?
4. What are the sources of information in the home that contribute to the rural child's notion of earth?
5. Is the amount of school instructional time on earth concepts related to notion level?
6. Is there a relationship between verbal ability and notion level?
7. Is there a relationship between ability to shift spatial reference frames and notion level?
8. Is there a relationship between children's earth notion level and sex, age, grade, achievement scores, and parents' years of education?

The following null hypotheses represent questions 2-8.

HO_1. There is no significant relationship between grade level in the rural, U.S.A. population.

HO_2. There is no significant relationship between the frequency distribution for each notion level by age in the rural U.S.A. population and the combined U.S.A., Nepal, and Israel population.

HO_3. Sources of information in the home are not significantly related to children's earth notion level.

HO_4. The amount of school instructional time spent on earth concepts is not significantly related to notion level.

HO$_5$. The relationship between verbal ability and earth notion level is not significant.

HO$_6$. There is no significant relationship between the ability to shift spatial reference systems and notion level.

HO$_7$. There is no significant relationship between earth notion level and age, sex, grade, achievement scores, or parents' years of education.

Alternative Conceptual Frameworks

The notion of "Earth" is a fundamental concept that children of all grade level should strive to understand. The earth notion has been defined as a spherical planet surrounded by space with objects falling toward the center of the sphere (Nussbaum and Novak, 1976, p. 535). These characteristics of our planet are essential prerequisites for the child to fully grasp such ideas as: What causes day and night? Why do we have seasons? How can people live on a ball and not fall off? Why does it get light in New York before it does in California? If a ball is thrown up into the air, will it always come back down? How is it that the top of a sail is the last thing we see as a boat sails out of sight? Why must we conserve energy, water and other natural resources?

Accommodation of this basic but complex notion of earth means the child must make a transition away from an egocentric point of view. He/she must take a viewpoint from outside his/her own personal reference frame. Educational research has repeatedly pointed out the existence of this transition in children's thinking. Robert Karplus, in this report on the Science Curriculum Improvement Study, remarks:

> It seems to me that in general this transition in children's thinking is not recognized by present educational practice in the United States. Teachers with whom I have been in contact have not seemed to be much aware that there is such a change taking place. I would say most instruction above kindergarten takes place on what we might call the formal level. (Karplus, 1964, p. 113).

Twenty years have passed yet the same statement could be made for much of the instruction in today's schools. Even in the secondary school, a majority of students are at a courses operational level while much of the instruction and subject matter in science courses is on a formal level (Lawson and Renner, 1975, p. 347).

If educators are to provide appropriate experiences for the development of a mature concept of the earth, they must first determine where the child is in his present understanding. What notion does he/she already have about our planet? When and how do these notions develop? A potential source of information for cognitive development is derived from the child's observations of natural phenomena, such as sunsets, clouds, and seasons as well as the more obvious, parental discussions, televisions, or books (Sneider and Pulos, 1983, p. 220). The literature is rich in research by psychologists such as Bruner, Piaget, Gagne' and Ausubel who recognize the sequential nature of cognitive growth and the importance of experience. Therefore, the major objectives of this study were to explore the developmental nature of the earth notion in a cross-age sample and significant home and school experiences related to the acquisition of earth concepts.

The variety of children's alternative frameworks of earth and their progression from an egocentric to a non-egocentric point of view is a result of both cognitive development and access to various sources of information. As a result of this development, the child comes to the instructional situation with an existing set of preconceptions. Preconceptions, misconceptions and alternative frameworks are used interchangeably in the literature. Preconception, as used here, is a term meaning preexisting conceptual framework. Educators must be aware when the preconceptions differ greatly from scientific conceptions. Ausubel, Novak and Hanesian point out that "preconceptions are amazingly tenacious and resistant to extinction" and the "unlearning of preconceptions might prove to be the most detrimentative single factor in the acquisition and retention of subject matter knowledge" (Ausubel, 1978, p. 372). It has been shown that when misconceptions are not uprooted, they may become even more elaborate and stable as a result of further instruction (Nussbaum and Novick, 1982, p. 185).

Central to the issue of developing a sequential organization for instruction is making teachers aware of their students' alternative frameworks or preconceptions (Nussbaum and Novick, 1982, p. 185). The term alternative framework is preferred by some since in fact many of the alternative explanations offered by children are examples of quite perceptive thinking. As Charles Ault (1984) put it, they are "intelligently wrong." Teachers have a tendency to listen only for right answers. Yet, "when thinking freely and expressing themselves without fear of being wrong, children often surprise us with thoughts that are novel but nonsensical or illogical...they are doing some creative albeit unpolished thinking" (Ault, 1984, p.24).

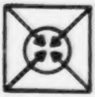
Nussbaum and Sharoni-Daga (1982, p.101) argue that children's alternative frameworks should always be considered in the development of curriculum, instruction and evaluation. Driver and Easley (1978, p. 65) however, in their review of literature on concept development in the physical sciences, point out that "development of a taxonomy of misconceptions does not give us interpretative power. Not until the reasons for the misconceptions are understood will progress be made in structuralized terms." There is a need to investigate the cultural background and experiences of children related to earth notion in an effort to uncover some of the reasons for the alternative frameworks about earth notion. There is also a need for the development of curriculum materials contrasting children's conceptions with scientific conceptions (Smith and Anderson, 1983). Continued expansion of our understanding of children's concept of earth notion will aid in curriculum development.

Earth Notion Research

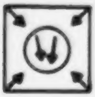
Joseph Nussbaum pioneered the research on children's notions of earth in his Ph.D. dissertation at Cornell University in 1972. Nussbaum and Novak (Nussbaum and Novak, 1976) conducted structured interviews assessing 2nd grade children's understanding of earth's shape, gravity and position in space. They also assessed the impact of audio-tutorial lessons designed to give instruction on the concept. Little progress was made as a result of audio-tutorial instruction in this early study; however, five qualitatively different notions were identified (Nussbaum and Novak, 1976, p. 535).

Nussbaum continued his research in 1979, studying the notion of earth held by 4th and 8th grade children in Jerusalem, Israel. He replicated his previous research using a slightly different interview instrument and found that older children also hold five distinct notions about earth's shape and gravity with varying frequencies at each age (Nussbaum, 1979, p. 83). Modifications in the original notion level scheme resulted in the following five earth notion levels, shown pictorially in Figure 1:

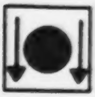
> Notion I refers to the belief that the earth is just as it appears to inhabitants on the surface--flat. Although children in the category are likely to say "round" when asked what they believe the shape of the earth is, further probing shows that they have an attached meaning to the words "round earth" that does not show conflict with their immediate perceptions. For example, some children believe that the round earth refers to curved roads or to mountains; others believe the earth is a circular island around which people can sail or fly; still others classified as Notion I



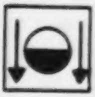
EARTH NOTION V · · THE EARTH IS SHAPED LIKE A BALL SURROUNDED BY SPACE. PEOPLE LIVE ALL AROUND THE BALL. THINGS FALL TO THE CENTER OF THE EARTH.



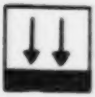
EARTH NOTION IV · · THE EARTH IS SHAPED LIKE A BALL SURROUNDED BY SPACE. PEOPLE LIVE ALL AROUND THE BALL. THINGS FALL TO THE SURFACE OF THE EARTH.



EARTH NOTION III · · THE EARTH IS SHAPED LIKE A BALL SURROUNDED BY SPACE. WE LIVE ON TOP OF THE BALL.



EARTH NOTION II · · THE EARTH IS SHAPED LIKE A BALL SURROUNDED BY SPACE. WE LIVE ON THE FLAT PART INSIDE THE BALL.



EARTH NOTION I · · THE EARTH IS FLAT.

FIGURE 1. EARTH NOTION CLASSIFICATION SCHEME

> believe that "Earth" is a planet up in the sky, where only astronauts go. Questions about gravity would make very little sense to children who hold Notion I.
>
> Notion II is a particular model of the world which retains the flat earth concept, but which also incorporates the ideas of cosmic space. When asked to explain their ideas about the round earth, these children claim that the earth is indeed a round ball in space, but people live "on the flat part of the middle." The upper half of the ball is the air, and the lower half of the ball is made of soil and rock.
>
> Children who hold Notion III understand that the earth they see is a tiny part of a great ball in space. They believe, however, that there is an absolute "up" and "down" in space, so that people can only live on "top" of a ball-shaped earth.
>
> Children who believe in Notion IV realize that we live on the surface of a great ball, represented by the globe, and that people live all around the ball without danger of falling off. Children whose responses are classified as Notion IV will correctly show how rocks fall when dropped just above the earth's surface, but will revert to the "absolute down" idea when asked to predict how objects fall when dropped into tunnels inside of the earth. For example, these children predict that a rock dropped from the North Pole into a hole dug straight through the earth will fall all the way to the South Pole and either land on the earth's surface somewhere near the edge of the hole, or "float freely" at its southern entrance.
>
> Children who hold Notion V understand that objects always fall toward the earth's center. In contrast to a Notion IV response that a rock will fall all the way to the South Pole, children at this level say that the rock will stop at the earth's center (Sneider and Pulos, 1983, p.208).

As pointed out in Nussbaum's research, changes in the child's earth notion are considered as "acts of cognitive accommodation." When children are presented with new information at variance with their existing conceptual frameworks, they must change their notion to accommodate this information. The new notion, however, may still not represent a scientific conception.

A study of 250 Nepalese children, ages 8, 10 and 12 (Mali and Howe, 1979, p. 685), compared the earth notion held by Nepalese children with those of children in the U.S.A. This study included the relationship of earth notions to: three Piagetian tasks, sex, parents' occupation, games, travel, number of languages spoken, grade, years of schooling, information sources and chores. Mali and Howe found very similar notion levels in the children of Nepal and of the U.S.A. Analysis of children's responses supported the hypothesis that notion level increases with age. Other variables found to be significantly correlated with notion level were: (1) level of cognitive development assessed by the Piagetian tasks of conservation, serration and classification, (2) number of years of schooling, and (3) sources of information available in the home (newspaper, radio, etc.).

Klein (1982) studied earth and sun system concepts of 2nd grade Mexican-American and Anglo-American boys and girls in St. Paul, Minnesota. The research was designed to determine if there were any differences in the responses of the two groups or between the sexes. No differences were found between sexes; however, Mexican-American children exhibited more preconceptual thinking than Anglo-American children. Many of the responses described by Klein were very similar to Nussbaum's findings; however, the models were sufficiently different and therefore prevent direct comparison (Klein, 1982, p. 95).

Nussbaum and Sharoni-Dagan's latest research tested the impact of a revised earth concept audio-tutorial instructional unit. The study involved 2nd graders in Jerusalem. A quasi-experimental design was employed where 2nd grade students' responses were compared with responses from 4th grade students who had no conventional instruction about the earth, and responses from 6th grade students who had received conventional instruction on the earth. Findings showed the impact of as little as 80 minutes of audio-tutorial instruction about the earth, equated to an increase in more than two years of incidental concept development. Nussbaum found in the study that primary age children are capable of learning major science concepts given "appropriate, carefully sequenced instruction rich in concrete visual aids and props" (Nussbaum and Sharoni-Dagan, 1983 p.99).

The most recent work of the earth notion studies was conducted in California with 3rd to 8th graders from the San Francisco Bay Area. Sneider and Pulos found once again a variety of earth notion levels and an increase in notion levels with age. Through their research Sneider and Pulos proposed an alternative model to the Nussbaum model for describing expected notion levels. The new model "offered a significant improvement in accuracy (with a small loss in precision). This model provides for an additional notion between Notions III and IV. Subjects in this category (14% of the sample) understood that objects fall towards the surface of the earth, but failed to grasp that people live 'under our feet,' on the other side of the world." In addition several other variables related to notion levels were analyzed. These included four psychological tasks and gender which previously were found to be significant predictors. Children with high verbal ability, males and children who were able to shift spatial reference frames performed better on the earth notion interview (Sneider and Pulos, 1983, p. 205).

An understanding of the earth notion is dependent on both experiences and cognitive development. It is important that the alternative frameworks of children be compared and contrasted with other views. This procedure may prevent further reinforcement and elaboration of less desirable views which make it difficult for future accommodation of a more formal conceptual view. The relatively few studies conducted on the subject of children's understanding of earth suggests the need for more information. There is a need to: (1) better understand the nature of children's earth notion, (2) verify the earth notion classification scheme, with different populations and (3) explore more fully other variables and experiential factors affecting earth notion.

The Children

The children studied were selected from the public schools in Meeker, Oklahoma, U.S.A. Meeker, with a 1979 population of 683, represents a small midwestern community. The study of rural children is in contrast with the previously studied urban and suburban populations of Ithaca, New York; St. Paul, Minnesota; San Francisco, California; and Jerusalem, Israel. Mali (1979) however, did include a rural population as well as an urban group in his study of children in Nepal.

The Meeker school district's population is predominantly rural, non-farm, basically caucasian with a small percentage of blacks and a sizeable population of native Americans. Meeker is approximately 35 miles east of Oklahoma City, the state's capital and largest city. Government is the largest single employer in the area, followed closely by manufacturing (Udell and Harmon, 1978).

The school itself is divided into the elementary school with grades K-5, the middle school with grades 6-8, and the high school with grades 9-12 (K-6 population = 360 students). The elementary school has two sections per grade with class sizes of 20-25 students per section. For this study 12 male and 12 female students were randomly selected from each of the K, 2nd, 4th, and 6th grade sections. The following 91 subjects were included in the study: Kindergarten--11 boys, 11 girls; 2nd--11 boys, 13 girls; 4th--12 boys, 10 girls; 6th--10 boys, 13 girls; total--44 boys, 47 girls.

Procedure

An important aim of this research was to replicate as closely as possible the procedures and instruments used in previous studies. Two tasks in addition to the earth notion interview were included. The verbal opposites task and the water level task were selected for inclusion due to their demonstrated significance in the California (Sneider and Pulos, 1983, p. 205) study. Mali (1979) used three Piagetian tasks as indicators of cognitive level. The water level task (another in the same line of Piagetian tasks) was used in the rural U.S.A. study as an indicator of cognitive development.

The other instruments used in this study were the earth notion interview format of Sneider and Pulos (1983) and the home and school sources of information surveys. The earth notion interview format has been found to be a valid method of identifying stages in the child's understanding of earth. The home and school sources of information survey questions were in part derived from the study by Mali (1979) in Nepal and in part from those developed by the authors specifically for this study in rural U.S.A.

A pilot study was conducted during April 1984 in Ponca City, Oklahoma, with 91 students in grades K, 2, 4, and 6. The pilot allowed for refinement of the interviewer's technique and wording of the home and school surveys.

A list of the instruments and a brief description of the structured interview follows:

1. Earth Notion Interview Format (Sneider and Pulos, 1983, p. 207) -- The interview consists of a series of open-ended questions exploring the child's concepts prior to being exposed to props or visuals. Props included a globe, detachable stick figures, two styrofoam balls with tunnels through them, and drawings to represent different spatial situations.

2. Water Level Task (Wadsworth, 1978, p. 268) -- This Piagetian task measures the child's ability to shift spatial reference frames. Three drawing of identical empty bottles are presented to the child one at a time. The child is asked to draw water in each bottle so that it is half full. The bottles are positioned vertically, horizontally and diagonally. This task is an indicator of cognitive level.

3. Verbal Opposites Task (Detroit Test of Learning Aptitudes, 1935/75) -- The task is a measure of verbal I.Q. As a word is read, the child is asked to respond with a word meaning the opposite.

4. Home and school Sources of Information Survey -- This instrument by the authors includes two parts, the survey for the parents and the survey for the teachers. The parent survey asks information about travel, television, books and conversations with parents about earth concepts, etc. The teacher survey was to determine the amount of time spent on instruction of earth concepts, as well as other school related experiences.

The study utilized a basic correlational design in which the dependent variables, individual children's notion level, was correlated with each of the independent variables: age, sex, achievement scores, parents' years of education, cognitive level (spatial ability), instructional time on earth concepts, verbal ability and cultural sources of information in the home. The earth notion frequency profile for the Oklahoma data was also correlated with the frequency profile for the collective U.S.A., Nepal and Israel populations.

Before beginning the interview procedure, 30 to 45 minutes was spent with each class (k, 2, 4, 6) conducting outdoor education activities. The purpose was to get acquainted and to ensure a more relaxed relationship with the children during the interviews.

Thirty to 45 minute interviews were conducted by the researcher with individual students. The earth notion interview was followed by the water level task and finally the verbal opposites task. Responses were tape recorded and annotated in an interview booklet.

A few variations in the interviews were necessary. Kindergarteners who indicated they had never heard of the earth were shown a model of the earth and asked if they had ever seen one before and what it was. If the child responded by saying it was the earth, the interview continued as before. For those who still had no idea of what the earth was, questioning was discontinued. Older students who showed discrepancies in their responses about gravity were asked additional questions at the end of the interview to clarify the child's intended meaning (i.e. What direction is down from various points on the earth's surface? Where is gravity strongest? On the surface? In the middle? Outside the ball? etc.).

After the completion of the interview procedure, home and school source of information surveys were sent to parents and teachers respectively. Sixty percent of the parent surveys and 100 percent of the teacher surveys were returned.

Data Analysis and Results

Interview data were analyzed and classified using the Nussbaum (Nussbaum, 1979) scheme. During the classification process several transitional levels were identified as well as one deviation from the five level scheme. Two students expressed a belief that gravity is in the atmosphere pushing things down to the surface. In all other responses those two exhibited an understanding at level 4. Therefore, in all statistical analyses they were placed at level 4. Students who were seen as being in transition were classified into the next lower level for purposes of statistical analysis.

Raw data were analyzed by computer. To compensate for the low frequency in some notion levels, combining the levels was necessary. Earth notion levels 1 through 3 were grouped to represent notions in which students exhibit an egocentric view of gravity. Levels 4 and 5 represent notions in which students have a much less egocentric view of gravity. For the comparison of Oklahoma, U.S.A. data and non-Oklahoma data the 7 through 9 year olds and the 10 through 12 year olds were combined.

Cognitive level, as indicated by the water level task, was determined as level 1 when the child related only to the spatial reference frame with the bottle held vertically, level 2 with the bottle held vertically and horizontally, and level 3 with the bottle held vertically, horizontally and diagonally. Verbal opposite raw scores were analyzed using standardized norms into mental ages (although raw scores were used in statistical analysis).

The test for trend in contingency tables was applied to determine the relationship between notion level and grade level. The correlation of notion level with age for Oklahoma and non-Oklahoma children utilized the Chi-square Test of Independence in contingency tables.

Statistical analysis of the relationship between the dependent variable, notion level and the independent variables of television, travel, planetarium/omniplex visits, games, literature, use of telescopes, globes, and family discussions was accomplished using multiple correlation and stepwise regression. Multiple correlation was also used to compare notion level with sex, age, grade, achievement scores, and mother's and father's years of education.

Spearman Rank Order Coefficient of Correlation (corrected for ties) was used to determine the individual correlation between notion level and cognitive level, notion level and verbal ability, and notion level and instructional time.

Statistical significance in all tests was predetermined and set at the 0.05 level of probability.

The results of analysis are presented in the same sequence as were the null hypothesis directing the study.

HO_1 There is no significant relationship between grade level and notion level in the sample population.

A profile of earth notion frequency by grade is presented in Table 1. Transitional levels are also indicated. Often a child gave responses revealing a partial understanding of higher level concepts. Therefore, these levels represent a finer discrimination in some students' understanding of earth notion. These students may actually be in a state of disequilibrium and optimal stage for instructional intervention.

The results of the test for trend analysis in Table 2 clearly shows a tendency for notion level to increase with grade. The relationship between notion level and grade is statistically significant (p=0.0012) therefore allowing rejection of the null hypothesis. The highest percentages of both kindergarten and second graders were in levels 1-3, while the highest percentages of 4th and 6th graders were in level 4-5. It is of interest to note that the 4th grade group had a higher percentage in levels 4-5 than did the 6th grade. The following three factors may offer some clues to this anomaly: (1) the 4th grade had slightly higher mean parent educational levels than the 6th grade, (2) 4th graders had higher mean achievement scores, and (3) the 6th grade teachers spent less instructional time on earth concepts than did 4th grade teachers.

HO_2 There is no significant relationship between the frequency distribution by age for each notion level in the rural Oklahoma and the combined U.S.A., Nepal and Israel population.

Kindergarten data was not included in the statistical analysis since no previous data on kindergarten existed for comparison. Using the Chi-Square Test of Independence in contingency tables, there was a statistically significant (p=0.0001) relationship between the Oklahoma and non-Oklahoma data. The Oklahoma sample had a higher frequency of students in the higher earth notion levels 4-5 than did non-Oklahoma samples. In the 7-9 year old group there were 50 percent from the Oklahoma population in the notion group, 4-5 as opposed to only 10.09 percent in 4-5 level in the combined group from U.S.A., Nepal and Israel. The 10-12 year old Oklahoma group also had 36.05 percent more in level 4-5 than did the non-Oklahoma population. Results are presented in Table 3. One explanation for these findings may be found in the research suggesting that

TABLE 1

NOTION LEVEL FREQUENCY PROFILE BY GRADE IN THE OKLAHOMA SAMPLE

NOTION LEVELS

Grade	0	1	1-2	2	2-3	3	3-4	4	4-5	5
K n = 22	3	10	0	1	1	1	1	4	0	0
2 n = 24	0	8	3	2	0	2	0	7	1	0
4 n = 22	0	0	0	0	0	2	4	6	7	2
6 n = 23	0	0	0	6	0	2	1	6	5	3

TABLE 2

CHI-SQUARE ANALYSIS OF THE RELATIONSHIP OF EARTH NOTION LEVEL TO GRADE LEVEL

Notion Level (clustered)		K	2nd	4th	6th	Total
1-3	Frequency	18.0	15.0	6.0	9.0	48.0
	Expected Frequency	11.6	12.7	11.6	12.1	
	Percent	19.78	16.48	6.59	9.89	52.77
4-5	Frequency	4.0	9.0	16.0	14.0	43.0
	Expected Frequency	10.4	11.3	10.4	10.9	
	Percent	4.4	9.89	17.58	15.38	47.25

Chi-Square = 15.81 DF = 3 P = 0.0012

TABLE 3

FREQUENCY DISTRIBUTION OF OKLAHOMA AND NON-OKLAHOMA NOTION LEVEL DATA BY AGE

Age Group = 7-9 Year Olds

		NOTION GROUP		
		1-3	4-5	Total
Oklahoma Data	Frequency	17.0	17.0	34.0
	Expected Frequency	28.7	5.3	
	Percent	50.0	50.0	100.0
Non-Oklahoma Data	Frequency	196.0	22.0	218.0
	Expected Frequency	184.3	33.7	
	Percent	89.92	10.09	100.0

Chi-Square = 35.81 DF = 1 P = 0.0001

Age Group = 10-12 Year Olds

		NOTION GROUP		
		1-3	4-5	Total
Oklahoma Data	Frequency	13.0	22.0	35.0
	Expected Frequency	24.5	10.5	
	Percent	37.14	62.86	100.0
Non-Oklahoma Data	Frequency	273.0	100.0	373.0
	Expected Frequency	261.5	111.5	
	Percent	73.19	26.81	100.0

Chi-Square = 19.83 DF = 1 P = 0.0001

children in rural areas have better spatial perceptual ability than children in urban or suburban areas (Butterworth, 1977).

HO_3 Sources of information in the home do not contribute significantly to children's earth notions.

Sources of information identified in the parent survey were found to contribute significantly to notion level. The Multiple Correlation Coefficient ($R = 0.76$) was statistically significant at the 0.01 level of probability, thus allowing rejection of the null hypothesis.

Close analysis of the experiences contributing in the multiple correlation equation reveals that time spent on tall mountains, time spent using telescopes, and time spent reading books about the earth were the three experiences contributing most significantly to notion level. A prioritized list of experiences is found in Figure 2.

HO_4 The amount of school instructional time on earth concept is not significantly related to notion level.

Teachers were asked to indicate the amount of instructional time they spent on earth concepts during the school year (Table 4). The kindergarten teacher reported that she did not spend time teaching earth concepts (however, a number of kindergarten students referred to their teacher as a major source of information). The two second grade teachers indicated that they spent about 90 minutes in earth notion instruction and two 4th grade teachers spent more than 90 minutes teaching earth concepts. The 6th grade teacher spent about 30 minutes of class time on earth concepts. The Spearman Correlation Coefficient for the relationship between notion level and amount of instructional time was 0.37 with $p = 0.0002$ making is statistically significant. Therefore, the null hypothesis was rejected.

HO_5 The relationship between earth notion and verbal ability is not significant.

The Spearman Correlation Coefficient for the relationship between the verbal ability and notion level was calculated as 0.69 ($p = 0.0001$), therefore allowing rejection of the null hypotheses. Verbal ability is highly correlated with notion level. This relationship was also found in the California study.

HO_6 There is no significant relationship between the ability to shift spatial reference systems and notion level.

FIGURE 2

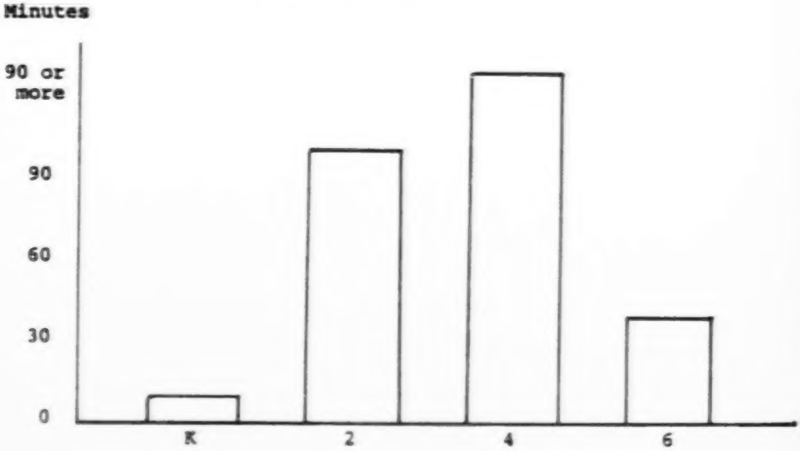
HOME EXPERIENCES CONTRIBUTING TO EARTH MOTION LEVEL

Time spent in the following experiences:

1. Trips to the Mountains
2. Using Telescopes
3. Reading Books
4. Parental Discussions of Travel
5. Parental Discussions of Earth's Gravity
6. Parental Discussions of Earth's Position
7. TV/NASA
8. TV/Karl Sagan
9. Parental Discussions of Earth's Shape
10. Trips to Planetariums
11. Parental Discussions of Day and Night
12. Use of Globes
13. TV/321 Contact
14. Games
15. TV/NOVA
16. Airplane Trips
17. Trips to the Omniplex (hands on science museum)
18. TV/Other Education Programs
19. Parental Discussions of TV Programs

TABLE 4

AMOUNT OF INSTRUCTIONAL TIME SPENT ON EARTH CONCEPTS IN ONE SCHOOL YEAR



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As stated earlier, the ability to shift spatial reference systems on the water level task is used here as a measure of cognitive level. Cognitive level was found to be statistically significant in its relationship to notion level having a Spearman Correlation Coefficient of 0.45 ($p = 0.0001$).

HO_7 There is no significant relationship between earth notion level and age, grade, sex, achievement scores and parents' years of education.

The multiple correlation coefficient for the relationship between the dependent and independent variables was calculated as $R = 0.7$ ($p = 0.0001$). A closer look reveals two variables as contributing most significantly to this multiple correlation. Student achievement scores and sex were significant at probability levels of 0.0014 and 0.013, respectively. The variable of sex was negatively correlated. A look at raw data on sex and notion level in Table 5 shows that more males ranked in the 4th and 5th lotion levels than did females.

Anecdotal Data

Only 5 of the 91 students interviewed failed to say the earth was round like a ball or some other spherical object. When asked what made them think the earth is shaped this way, it was clear they did not all conceive the spherical earth in the same way. Here are some of their responses.

1. (Kindergarten Boy) "I saw it when it dark up in the sky. There are two; one is flat and the one up in the sky is round. We're on the flat one."
2. (Second Grade Girl) "Because when you look up in the sky it looks like this round ball all around us." (Figure 3).
3. (Fourth Grade Girl) "Probably so if you went too far you wouldn't fall off. A long time ago a man named Columbus went to sail the seas and he went to prove the earth was round. He succeeded and then everybody knew it was round."
4. (Sixth Grade Boy) "Because it's not flat. Back in the old days they thought it was flat. But it's not. There's no way."

(Why Not?)

"Because, it's just round. I don't know why."

(How did you come to know it was round?)

"I don't know. I just thought it was round."

TABLE 5

EARTH NOTION LEVEL FREQUENCY DISTRIBUTION
BY SEX AND GRADE

NOTION LEVELS

Grade	Sex	1	2	3	4	5	Total
K	M	5	1	1	4	5	11
	F	10		1			11
2	M	3	1	2	5		11
	F	8	1		4		13
4	M			2	9	1	12
	F			4	5	1	10
6	M		2	1	4	3	10
	F		4	2	7		13
Total by Sex	M	8	4	6	22	4	44
	F	18	5	7	16	1	47
Total by Level		26	9	13	28	5	91

(Does it look round?)

"From space it does and it turns."

In his drawing (Figure 4) we can see other celestial bodies are drawn above the earth. When questioned further, he said there were planets below the earth but no space. He also indicates in later drawings that only things on top of the earth stay. Things on the "sides" or "bottom" fall off!

The question of where we must look to see the earth as well as the explanations for why one drawing shows the earth flat while the other is like a ball were very helpful in singling out children who believe in two earths. These children consistently said we must look to see the ball-shaped earth and the two pictures show the flat land we live on and the ball that is up in space. Some said people could live on the ball while others claim this is impossible. These questions also identified students who think they live inside the earth. The following transcriptions are representatives of this idea.

(Where is the earth?)

5. (Kindergarten Boy) "Up there."

(So the earth is up above us?)

"Uh huh."

(It's not down here.)

"Well we're on the earth. It's all around us...We're in the earth but we can get out in a rocket."

(Why does the earth look flat if it's really round?)

6. (Second Grade Girl) "Because it's great big and it's flat here (in the middle)."

(What's up here? top half of the ball)

"Sky."

(Where would we be on this ball?)

"Right here." (in the middle)

(Could you stand on the surface?)

"No. we're inside the ball." (Figure 3)

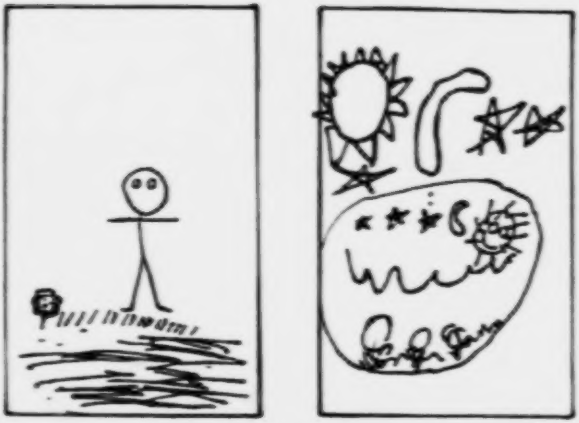

FIGURE 3
SECOND GRADE GIRL

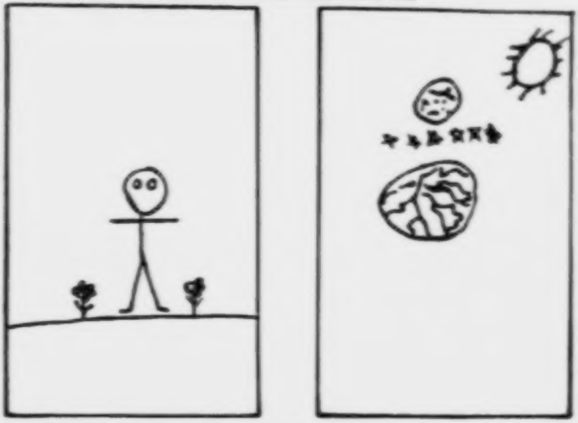

FIGURE 4
SIXTH GRADE BOY

(IN THE LEFT-HAND FIGURES, THE CHILDREN WERE ASKED TO DRAW THE GROUND UNDER THEIR FEET AND SOME THINGS NEAR THEM. THEY WERE ASKED TO DRAW A PICTURE OF THE EARTH IN SPACE, SHOWING THE SUN, MOON, AND STARS IN THE RIGHT-HAND FIGURES.)

7. (Sixth Grade Girl) "The earth is all around you. You can look any direction and see part of the earth...Well the earth it seems it never ends. Half of the ball, like the land here and the earth is round. So the earth is like this (gestures to show a ball) but the land is flat here."

Responses to questions on gravity were also quite varied. When asked to predict what would happen to water in bottles sitting on the South Pole 63 percent of the kindergarten and 2nd grade students said the water would pour out and 33 percent of the 4th and 6th grade students gave a similar response. Many said that you couldn't stand there and the bottles would fall either into space or to the ground below. Most curious though were the children who claimed the water would pour out but gravity would hold people and bottles on the surface.

The problems of rocks falling at several different places on the surface of the earth again helped differentiate children's overall understanding of shape and gravity. (Figure 5)

8. (Second Grade Boy) "Well to a big island there. They end up on a big island." (Figure 5)

(The rocks would stay there?)

"Yes, but we wouldn't, we'd go off into space." (See Figure 4)

(What's up here? top half of the ball)

(Why would we go into space but the rocks would go down?)

"Because the rocks are on earth and there's 'hazium' or whatever you call that keeps you down on the earth."

(So this rock would go down but the person would go up. Why wouldn't the rock go up?)

"Maybe it would."

(Why wouldn't the person go down?)

"Because it's space and has no helium to keep you down. What do you call that? The thing that makes you stay down on the earth? I can't remember that word."

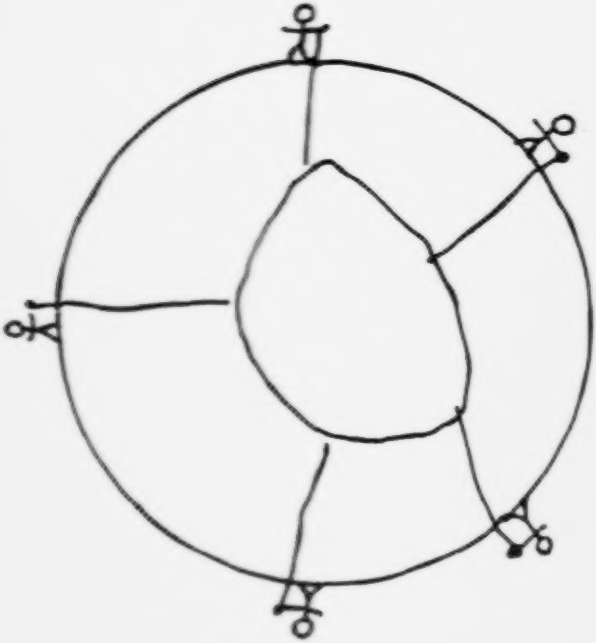

FIGURE 5

Second Grade Boy

(Gravity?)

"Yes, gravity!...Really people and the rocks would both go out in space."

9. (Kindergarten Boy) "They would drop on the ground."

(Will they stay there?)

"Yea."

(They won't roll off?)

"No."

(Why not?)

"Because of gravity."

Answers to questions about objects falling inside the earth made the final distinction between level 4 and level 5. Eight students predicted that rocks would fall to the center of the earth. Most students (66%) predicted the rock would either drop down and out the other side or down and out then loop back to the surface.

Finally children were asked where they learned about the earth's shape and how things fall. The highest frequency of Kindergarten children gave home as their major source of information but most 2nd, 4th, and 6th graders gave school as their primary source.

Summary and Discussion

The intent of this study was to identify earth notions held by elementary students in a rural Oklahoma community and some of the significant independent variables related to development of these earth notions. Using the structured individual interview procedures suggested in previous studies on earth notion, it was possible to identify and categorize the earth notions of Kindergarten, 2nd, 4th, and 6th grade students. Results of these interviews support the finding of past research. Children in the rural, U.S.A. sample generally held the same notions of earth as did children in other studies. Surprisingly, the distribution in the rural sample was skewed more toward upper notion levels than was the distribution of urban children. This seems to support the idea of greater development of spatial perceptual ability for rural children. However, interpretation of the results must not overlook possible discrepancies. The pre-interview activities conducted to ensure better rapport with the rural U.S.A. children may also have improved the responses.

A number of independent variables have been included in past research to help account for the variance in earth notions by children and have been found to be significantly related. Of these, age, sex, grade, parents' years of education, achievement scores, verbal ability, and spatial ability were included in this study in an effort to further validate these findings. Although support was found for the significance of all the above sources of variance, verbal ability, spatial ability, achievement scores, and sex were determined to be the more reliable predictors of notion level. Other studies had not looked extensively into the sources of information in the home and school which contribute to earth notion (with exception of Mali). However, both home and school activities were found to be statistically significant in this study. The parent and teacher surveys were successful in identifying important experiences to which children have been exposed. Further development and refinement of these survey instruments should be continued.

There is a degree of readiness for earth notion subject matter as early as kindergarten. In the kindergarten sample, 18 percent were classified at level 4 and another 13.6 percent held notions 2 or 3. Of those kindergartners who demonstrated a relatively high understanding of earth concepts, most had been exposed to a wide variety of family experiences in the home including travel, books, science museums and especially discussions with parents.

Many experiences, although intended to clarify meaning and further the child's understanding, may in fact further elaborate this misconception. The 6th graders in this study may be an example of such a case. Twenty-six percent of the 6th graders interviewed believed we live inside the earth (Earth Notion level II). These students were generally average in verbal ability and achievement scores. How did these preconceptions develop? These students had received formal instruction beginning in 2nd grade and yet their understanding is seen as conceptually naive when compared with external criteria. One surprising explanation for this anomaly came during a discussion about why they believe we live on a flat surface in the middle of the sphere. Several 6th grade students related their experience in 5th grade of visiting a planetarium. They talked about how the sky looked curved and how we were in the middle. It seems very possible that the root of their alternative framework was the experience of seeing the sky projected on a curved ceiling with a flat floor at the planetarium. We can see here the importance of exposing these ideas before they become stable and the foundation on which the child attempts to assimilate later learning. Although this explanation is yet untested, the implication should be of special interest to planetarium directors and all instructors alike.

The emphasis in the earth notion research to date has been placed primarily on understanding the development of children's concepts, improving methods for exposing their ideas and developing better instructional strategies. The importance of the earth concept itself, although it may have been implied, has been a secondary emphasis. As advances in technology continue and as natural resources become more and more a limiting factor, the significance of this basic concept becomes increasingly clear.

Children develop basic attitudes at a young age, and when those attitudes are guided by major misconceptions, the effect may be carried into adulthood where significant resource management decisions are influenced. The research reported here supports previous studies showing the prevalence of alternative frameworks in children of many ages even after receiving formal instruction. Attitude toward the earth's resources and a sustained high quality of life will be influenced by how we perceive our planet. Although it has not been the purpose of this study to investigate children's attitudes toward the earth, the need for such research is evident.

Future Exploration

A number of unanswered questions surfaced as a result of this study. For example, during interviews with kindergarten and 2nd grade children, the influence of older siblings on younger children's level of understanding was sometimes mentioned. This source of variance needs further investigation either as part of the earth notion interview or as part of the home survey.

It has been suggested that the interview itself may be instructional. Therefore, an experimental design with an interview followed by another interview one to two months later could offer important suggestions for development of improved instructional design.

Textbook authors and environmental curriculum planners should consider the major preconceptions of children when developing curriculum materials. Teachers' guides need to include ideas for sequential concrete experience for teaching concepts such as the earth's shape, gravity and position in space. Existing texts should be analyzed to determine contents that contribute to earth notion development. It would be beneficial to have discrepant event activities included in texts to create cognitive dissonance and stimulate children's accommodation of a more mature earth concept.

Classroom teachers must become aware of children's preconceptions before beginning any environmental education. It cannot be assumed that because a concept was covered last year the child has accommodated the necessary learning free of major misconceptions. It is essential to begin where the child is, and this requires more listening on the part of teachers to assess this level. Correct answers on paper and pencil tasks are not always the best measure of the child's true level of understanding. As suggested in other studies, the Piagetian clinical interview method should be utilized more often by classroom teachers to assess student progress. For example, two students expressed a belief that gravity is in the atmosphere pushing things down. This kind of preconception must be identified by the classroom teacher. In fact, additional interview questions need to be included which explores this preconception. It is very possible that other level 4 children may have held this idea; however, it was not identified in this study.

Kindergarten children must not be ignored! Other studies found 2nd graders with definite alternative frameworks already in place. These ideas certainly had their roots in much earlier experiences. Any real attempt to understand the development of the earth concept and its influencing factors should begin before major preconceptions develop. Developing a rich base of experiences at the primary and preschool level will certainly enhance the growth of preconceptions compatible with mature earth concepts. An environmental earth notion teaching unit should be developed and tested in kindergarten.

The curious question of the effect of trips to the planetarium on children's notions of earth will require further study before any serious conclusions may be drawn. A pre-interview followed by a planetarium trip and post-interview would be a good place to start. Perhaps one group might have some preparatory remarks prior to the planetarium show to sensitize them to the discrepancy in their perception while another group would receive no explanation. The possibility that the planetarium environment promotes developing a level two earth notion needs investigation.

Finally, and perhaps most important, children's attitudes toward conservation of resources, the biosphere or other environmental issues could be correlated with earth notion. Would children with less egocentric views of the earth have more positive attitudes toward conservation of natural resources? If so, this would add real support to the importance of developing level V earth notions in students. In addition, the earth concept's place in research and curriculum development, especially in environmental education, would be given appropriate emphasis.

The study reported here supports research from California, New York, Israel, and Nepal. Regardless of the cultural setting or the sophistication of the population, major alternative conceptual frameworks of the earth do exist. In addition, it would seem that children worldwide develop similar notions about the earth. Educators concerned with promoting a greater understanding and appreciation of our planet earth, should find the research presented and cited here of special interest. We must join in a global effort to understand the nature of development of the earth concepts in children and the relevant experiences promoting development of these concepts. With this knowledge we may then have greater educational impact on children who upon becoming adults must make responsible decisions concerning the resources of a finite earth.

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EVALUATION IN ENVIRONMENTAL EDUCATION: TIME FOR CHANGE IN PERSPECTIVE?

by

Ian Robottom

ABSTRACT: The Tbilisi conference on environmental education recommended that research be carried out on "...the epistemological and institutional structures that affect consideration of environmental demands..." and "...the obstacles (epistemological, cultural or social) restricting access to educational messages and their utilization". It is argued in this paper that some of the obstacles referred to in these recommendations are embedded in the way in which *research and evaluation* of environmental education tend to be organized. Conventional approaches, characterized by centrally-controlled research, foreclosure of debate about goals, reliance on centrally-produced instructional materials, and power-coercive models of change fail to address the real problems encountered by practitioners in their particular professional situations.

Alternative approaches exist, enabling a *deliberative* choice of appropriate research and evaluation for environmental education. It is contended in this paper that given the nature of the problems encountered by practitioners in realizing the socially-critical aspirations of environmental education, *critical approaches* to research and evaluation are both the best justified and the most promising approaches for environmental education.

Introduction

The intergovernmental conference on environmental education (Tbilisi, Russia, 1977) developed a number of recommendations intended to be influential in shaping the innovation over the succeeding years. The most oft-quoted of these recommendations are those concerning the "role, objectives and guiding principles of environmental education". The conference also made a number of recommendations about *research*; two of these recommend that member states of the United Nations carry out research concerning "...the epistemological and institutional structures that affect consideration of environmental demands..." and "...the obstacles (epistemological, cultural or social) restricting access to educational messages and their utilization" (UNESCO, 1980). It is in the spirit of these latter two UNESCO recommendations that this paper is written. The thesis of the paper is that the assumptions of the currently dominant approach to evaluation in environmental education in fact support the constraints that environmental education practitioners encounter in attempting to improve their environmental education practice.

Environmental education over the last fifteen years has been closely associated with the work of the UNESCO/UNEP program in environmental education. The landmark events of modern environmental education were the conferences at Belgrade (1975) and Tbilisi (1977); the language of the environmental education movement is still dominated by that of the Belgrade Charter. One of eight "trend papers" presented at influential working sessions at Belgrade was on the topic of evaluation in environmental education. The question addressed here is whether the environmental education movement is now in need of a change in perspective on evaluation and educational change.

The environmental education movement since Belgrade has had a chequered history, with conflicting points of view evident at various levels. Conflicting points of view have been expressed at the level of language (for example, does the essence of environmental education reside in its "education about the environment" or nature studies form, or in its "education for the environment" or environmental problem-solving form?); at the level of organization (for example, is improvement in environmental education programs best achieved through centre-periphery approaches, or through local school initiatives?), and at the level of practice (for example, does environmental education entail a change in habitual teaching patterns?).

The Belgrade trend paper on evaluation in environmental education was written at a time when considerable conflict and rethinking were also occurring in the field of educational evaluation. The hold of the dominant quantitative, scientific/analytic approach to evaluation (rightly exemplified in the Belgrade trend paper as "the state of art") became contested by such alternatives as interpretive and critical approaches. Methodological issues debated in this period of reconceptualization in the field of educational evaluation include epistemological dilemmas (for example, is it reasonable to sustain a notion of objective knowledge?), ethical dilemmas (for example, whose interests is the evaluation serving?), and procedural dilemmas (for example, where does the locus of control of the evaluation reside?). However, developments in the field of environmental education appear to have been insulated from the influences of these debates in the field of educational evaluation. As the recent review of research in environmental education conducted by the North American Association for Environmental Education (NAEE, 1982) shows, the dominant paradigm of evaluation in environmental education remains a "scientific/analytic" one.

The proposition has been advanced (see "Editorial", Journal of Environmental Education, Summer 1982) that the appropriateness of conventional approaches to evaluation of environmental education needs to be regarded with suspicion. The intention in this paper is to address this proposition by considering the resonances between two different perspectives to evaluation on the one hand, and commonly-accepted characteristics of environmental education on the other. Both perspectives to evaluation (scientific/analytic; and critical) will be considered in respect of their epistemology, interests served and locus of control, --- in short, in respect of their "political theory". Finally the argument will be advanced that the choice of evaluation paradigm for environmental education be a deliberative one based on the relationship between the "political theory" of the evaluation approach, and the intentions of the program to be evaluated.

(i) Scientific/Analytic Approaches to Evaluation

Scientific/Analytic approaches are typically used to determine the effectiveness of a program. Congruence between goals and outcomes is measured quantitatively and presented as an indicator of program effectiveness. The evaluation design is one in which learners are pre-tested and post-tested, and attempts are made to identify and control most of the variables in the educational setting; the effect of the changed activity in a program, or a "new" program, in achieving the program's objectives is determined. The instruments used to measure student performance are developed by the researchers; an appropriate statistic is employed to measure for statistically significant shifts in student performance in the groups "exposed" to the materials or activities of the program. Scientific/analytic approaches to evaluation are frequently used in the context of a centrally-controlled process of development of new curriculum materials (as in "Research, Development, Diffusion, Adoption" models). Scientific/analytic approaches to evaluation and centre/periphery models of educational change are based on similar view of the professional competence of teachers -- the view that teachers are educational technicians passively adopting the educational materials developed through the activities of outside researchers.

(a) epistemology

The view of knowledge sustained by scientific/analytic approaches to evaluation is, in a word, objectivist. The main features of this view are:

- direct observation of perceived things and processes provides the ultimate link between scientific knowledge of the world and the world itself;

- the reality of the world of which we have knowledge is independent of the researcher;

- there are observational terms which are themselves theory-independent units of meanings;

- the actual practice of science -- involving the process of justification, the testing and validation of theories and hypotheses -- is a rational process;

- scientific knowledge is cumulative and progressive (Codd, 1981, p. 3).

The objectivist character of the view of knowledge assumed by scientific/analytic approaches comes through in the features listed above. There is an emphasis on the empirical -- on testing through recourse to observation and experience -- and on knowledge that is objective in the sense of relating to objectively existing reality, in the sense of being able to be expressed in value-free language, and in the sense of being generated through a process which itself seeks to eradicates the influence of values.

(b) The emphasis of scientific/analytic approaches on the empirical devalues that which cannot be directly or indirectly tested by recourse to observation or experience. Since scientific knowledge is thought to be generated through a process of rigorous emperical testing, within an "open society" or critical community, of propositions which are in principle capable of refutation, it follows that propositions which are not susceptible to empirical test cannot be scientifically confirmed. From a scientific/analytic perspective, then, valuative elements such as the normative and ideological cannot gain the status of legitimate knowledge. Thus in scientific/analytic approaches to evaluation, ideology or values embedded in the goals of an educational program are not scrutinized. That is, while the fidelity between intentions and outcomes can be determined, the intentions themselves are beyond critique -- and the individuals and institutions responsible for establishing the intentions are similarly beyond question and hence beyond critique. The effectiveness of programs and teachers is instrumentally determined in a process which preserves the interests of the administrators of the educational program or institution. Structural or institutional impediments to the sort of curriculum change entailed by environmental education are not engaged in any serious, searching way by teachers as part of their involvement in the evaluation. Thus these impediments (for example: disciplinary curriculum structures; habitual teaching patterns; administrators' conservative beliefs about the "dangers" of educating through involvement in controversial environmental issues) are reinforced as being in some sense objective, fixed and not amenable to change through the activities of teachers.

(c) locus of control

In scientific/analytic approaches to evaluation, the locus of control resides firmly with the evaluators, or their employers. The need for sophisticated statistical procedures in a thorough quantitative evaluation of a program favors a situation in which the visiting "evaluation expert" is in control of the evaluation, and in which program participants (teachers and students) remain in a state of mystification. Since in scientific/analytic approaches educational decision-making is associated with expertise in the application of the scientific method and in statistical analysis, teachers often tend to be excluded from the very educational decision-making which to some extent determines their lives. a clear example of this sharp division of labor and of the exclusion of practitioners from the community conducting the evaluation is presented by Strickland et al (1983, p.33) in a recent article in the Journal of Environmental Education. The paradox is that practitioners, those individuals who are closet to and most informed about the program, are as a matter of policy removed from what ought to be (given the purportedly scientific base of the evaluation) an "open society" engaged in the improvement of the program.

Scientific/analytic approaches, then, tend to "disempower" practitioners and to ascribe them the status of pawn in the process of curriculum improvement. They typically do this in environmental education by:

* co-opting the language of environmental education. They show a propensity for setting or protecting certain goals for teachers -- goals which are not necessarily the outcome of teacher deliberation -- and for foreclosing debate about such goals

(definitions; aims; guiding principles) in a way which protects the interests of the authors and researchers of the goals.

* assuming uncritically that the educational change required for improvement of environmental education can be brought about through centrally-produced and disseminated instructional materials.

* assuming that the research associated with these goals is best done by central personnel (specialist researchers; members of the "academy"), and that teacher trainers and teachers themselves ought to accept this research uncritically.

* advocating a power-coercive model of change, where improvement in environmental education is sought through change imposed on the educational community by a superordinate political/legislative system.

* adopting a competency-based form of professional development in which the "competencies needed by teachers to enable them to become effective environmental educators" are set by the researchers themselves.

There is a contradiction embedded in the rationale for such approaches to evaluation and research in environmental education. They tend to be based on a criticism of the propensity of practitioners for educational decision-making that is "intuitive" rather than "empirical". They recommend a form of organization in which practitioners accept as given the goals of environmental education determined or endorsed by others -- by the researchers themselves. However, this form of organization dissociates the "theory" of environmental education (this remains the domain of the "academy") from the practice (the work of practitioners). This denies practitioners the opportunity to theorize about and research their own practice -- and thereby actually perpetuates "intuitive" decision-making. To prescribe power-coercive models of change and to hawk centrally-determined goals until "the message is internalized" is to reduce the professional status of practitioners to empty, passive recipients who must accept as an article of faith (that is, intuitively) the goals embedded values of goal-setting academy. Practitioners, to be "competent", must conform with criteria identified by the academy. It is in this sense that practitioners are "disempowered" in scientific/ analytic approaches to evaluation and research, and in this sense that the *locus of control* in such approaches is external to practitioners.

(ii) *Critical approaches to evaluation*.

Critical approaches to evaluation are represented here by *action research*. Educational action research seeks to *democratize* evaluation, involving practitioners as participants, *as equals*, in a form of educational research for educational improvement. Action research recognizes that teaching, and educational practice in general, is complex, problematic and uncertain and takes place in a context that is complex, changeable and politically-motivated. It is characterized by a method comprising recurrent cycles of three phases. There is a *Planning* phase, in which existing personal practice is regarded as problematic (as imperfect and potentially requiring of change). The individual teacher looks for dissatisfactions, or areas with room for improvement, in his/her own teaching. "Dissatisfactions" and "improvement" are terms whose meaning is embedded in theoretical discourse about the nature and purposes of the innovation -- the sense in which improvement of a particular practice is understood can be traced to a particular conception of the innovation held by the teacher. What is "planned" in this phase is teaching/ learning activity in which it is possible to exercise or manifest the sought-after improvement. The *Action* phase occurs when the plan is put into practice in an educational .setting. In addition to trying to manifest a desired improvement in a teaching/learning activity, the teacher organizes a means of *monitoring* the events in that process (for example, the activity may be videotaped or audiotaped). The means of monitoring must be capable of detecting and recording when an improvement (in the teacher's own terms) has occurred. The third phase is *Reflection*: in this phase, the data collected from monitored action are analyzed. In particular, the teachers reflect critically on the relationship of their practice (the monitored action) and their view of the innovation (their "theory" of the innovation. They may ask such questions as "Was improvement evident?"; "Did it go far enough?"; "What further changes to my practice might enable further improvement?"; "What institutional barriers were encountered in this attempt at improvement?"' "What assumptions about teaching, schooling, or this innovation were evident in my practice?"' "Is my conception of the innovation (my theory) in need of adjustment in light of this practical experience?".

In the light of undertakings generated in this three-phase action/research cycle, the next *Planning* phase is entered. Action research, then is mediated by *praxis*, a process of critical reflection upon personal improvement through praxis applied at the level of the relationship between thought and action: that is, it seeks to involve the participant in critical reflection on the relationship between personal educational philosophy and personal educational practice. Action research also aims at program and institutional improvement through praxis applied at the level of the relationship between individual action and societal (program or institution or society at large) structure and function. Action research contributes to rational decision-making in the sense that the teacher (or group of teachers) is able to choose between alternatives whose respective rationales have been subject to deliberation.

(a) epistemology

The epistemology of critical approaches to evaluation is that knowledge is dialectical, an "interplay of subjective views of the world and the historical and cultural frameworks in which they are located" (Kemmis, in press). Knowledge is not objective -- independent and in some sense value-free. Knowledge is constructed through social interaction, and can be understood (or have meaning) in particular actions or projects. The significance of these actions or projects is itself resident in specific historically embedded and socially constructed. (In contrast, scientific/analytic approaches see truth as being independent of historical and social circumstances). Educational practice is seen as praxis (a dialectic): it is action which at once is informed by a set of guiding assumptions (the practitioner's theory) and informs (transforms) those guiding assumptions. Educational practice on this view is a process of "hypothesis testing" through action; this "hypothesis testing" informs practitioners about the adequacy of their "theory" (how they understand their work) and about the opportunities and limitations of the context of practice (their educational setting).

(b) interests

Critical approaches like action research seek to promote a debate among participants in the program -- a debate in which participants engage in a process of self-reflection about the relationship between their own "theory" (guiding assumptions) and practice, and about the relationship between themselves as increasingly conscious professionals and the context in which they work. Such approaches are critical in the sense that they are "predisposed toward ideology-critique: toward the recognition and negation of educational ideologies which serve the interest of specific groups at the expense of others" (Kemmis, in press). The interests of action research are emancipatory in the sense that it aims at freeing participants from "the mystification of ideology, the dictates of habit and precedent, and the compulsions of self-interested authorities" (Kemmis, 1980, p. 26). Above all, critical approaches seek to transform educational organizations and practices to achieve rationality and social justice.

(c) locus of control

The locus of control is internal. The teacher is the researcher: it is the teacher who proposed the hypothesis (that improvement is possible), who empirically tests the hypothesis through his/her own practice, who establishes the nature and extent of the improvement, and whose decision it is to act upon the outcomes of that research. The process is one in which teachers conduct the evaluation and use its outcomes to gain greater understanding of, and hence personal control and responsibility over, their own teaching performance. The outcomes -- understandings about teaching and the possibilities and limitations for improvement offered and imposed by the institutional context -- are grounded in personal praxis and are therefore "owned" by the participant. Access to and release of information is controlled by participants in the research. Ownership (of an internal locus of control) is protected by commitment of all participants to a set of negotiated "principles of procedure" which govern the research (Kemmis and Robottom, 1981, p. 152ff).

As a form of evaluation, action research redefines "evaluation" away from a process of accountability to authority and towards a process of informed educational change. Whereas scientific/analytic approaches place teachers in a subordinate, acquiescent stance with respect to their personal professional predicaments (that is, their situations, administrations and institutions), critical approaches create the conditions for teachers to engage in critique of those predicaments. Among the key points of educational action research listed by Henry and Kemmis (1985) are the following:

* it is an approach to improving education by changing it and learning from the experience of change.

* it is participatory: it is research through which people work towards the improvement of their own practices (and only secondarily on other peoples' practices).

- it is collaborative: it involves those responsible for action in improving it, widening the collaborating group from those most directly involved to as many as possible of those affect by the practices concerned.

- it establishes self-critical communities of people participating and collaborating in all phases of the research process: the planning, the action, the observation and the reflection; it aims to build communities of people committed to enlightening themselves about the relationship between circumstances, action and consequence in their own situation, and emancipating themselves from the institutional and personal constraints which limit their power to live their own legitimate educational and social values.

- it involves people theorizing about their practices -- being inquisitive about circumstances, action and consequences in coming to understand the relationships between circumstances, actions and consequences in their own lives.

- it requires that people put their practices, ideas and assumptions about institutions to the test by gathering compelling evidence which could convince them that their previous practices, ideas and assumptions were wrong or wrong-headed.

- it involves people in making critical analyses of the situations (classrooms; schools) in which they work: these situations are structured institutionally.

It is in this sense that critical approaches to evaluation and research seek to emancipate practitioners and to sustain an internal locus of control.

Evaluation in Environmental Education: A Deliberative Choice.

The foregoing has attempted to establish that different approaches to program evaluation embody different political theories: they are based on different views of knowledge, enable differing degrees of control by participants themselves, and serve the interests of different constituencies. These differences enable, and create the responsibility for, a choice of approach to evaluation that is deliberative -- one which is taken only after careful consideration of the relationship between the spirit and intent of the program to be evaluated and the political theories of contending evaluation approaches.

What do we know about programs in environmental education? First, it is fair to regard environmental education as an innovation. Environmental education is not at this time institutionalized (Hungerford, 1983, p. 3). It continues to represent a challenge to existing patterns of schooling. Its inquiry orientation is a challenge to habitual patterns of teaching; its interdisciplinary character is a threat to conventional disciplinary curricular structures; its emphasis on outdoor education presents problems for existing organizational patterns. These challenges are political in nature in that they call for a change in the status quo, and frequently result in competition for resources within schools. To the extent that environmental education is an innovation, the processes by which it seeks to become institutionalized are necessarily political processes involving deeper questions of ideology. For example, teachers attempting to develop and implement an issue based form of environmental education courses speak of problems like:

* the constraints that a rigid timetable imposes on an issues-oriented form of environmental education involving visiting speakers and extended "town meeting"-style debates. Team teaching arrangements result in individual action interacting with the greater school organization. The issue here is the constraints imposed on individual development by institutional structures;

* excursions can only be conducted within walking distance of the school because of unaffordable bus costs: the political effects of the innovation, in this case the allocation of scarce resources, reach parents and administrators;

* while the environment within walking distance of the school has a number of environmental problems in it (problems which to the teacher seem to be interesting and informative examples of environmental exploitation or social injustice), the pupils were not interested in these problems: the issue here is the dilemma inherent in a "negotiated curriculum" -- should the teacher direct pupils to investigate certain environmental issues, or should issues to be investigated be selected through a process of negotiation aimed at preserving pupils; intrinsic motivation;

* while there is a great range of curriculum materials available, none seems to offer guidance for dealing with the specific problems encountered when addressing particular controversial environmental issues: the issue is the limitations of the view of "curriculum as materials";

- regular assessment procedures in which pupils are tested for their ability to recall specific factual information seem inappropriate to a form of environmental education aimed at investigating local environmental issues: this is the issue of the relationship of assessment to curriculum;

- pupils seem unprepared to question authority figures (e.g. councilors; public service officials; any adult participants in any environmental issue): this is the issue of authoritarianism in schools.

In addition to the fact that environmental education, like all innovations, is political because it creates competition for time, finances, and involves value judgments about such things as the relative importance of the new program and established subjects on the part of students, teachers, administrators and parents, environmental education is also political in what it substantively seeks to do in an educational sense. This additional political dimension distinguishes environmental education from many other innovation efforts: it explicitly seeks to develop a socially-critical orientation among its students. Students are encouraged to engage in critical thinking about controversial environmental issues -- issues which inevitably depend for their existence on differing value judgments. The socially-critical orientation of environmental education is clearly prescribed in an official UNESCO report on the Tbilisi intergovernmental conference:

> environmental education should adopt a critical approach to encourage careful analysis and awareness of the various factors involved in the (environmental) situation... All decisions regarding the development of society and the improvement of the lot of individuals are based on consideration, often implicit, concerning what is useful, good, beautiful and so on. The educated individual should be in a position to ask such questions as: Who took this decision? According to what criteria? With what immediate ends in mind? Have the long term consequences been calculated? In short, he must know what choices have been made and what value-system determined them (UNESCO, 1980).

That is, environmental education has a socially-critical quality in the sense that it seeks to involve pupils in an investigation of environmental issues with a view to understanding and mounting a critique of the arguments, evidence and value positions at work in respect of those issues.

Given that environmental education as a curriculum innovation in schools has this twofold political character (because of its challenge to the status quo of schooling and because of its socially-critical intentions), what form of educational evaluation is the prudent choice?

In order to deal with the political aspects of a socially-critical education like environmental education, practitioners need to be empowered in their professional predicaments, rather than caused to adopt subordinate positions with respect to them. Practitioners need to be enabled to mount a critique of, and to engage in corrective action aimed at changing, the constraints within which they operate. Scientific/analytic approaches to evaluation fail to do this.

The proposition advanced in this paper is that the form of evaluation best equipped to deal with the epistemological, ethical and procedural dilemmas to arise when trying to understand and improve an innovative, socially-critical form of environmental education is a critical approach to evaluation. The "bones" of the argument are as follows:

* educational decisionmaking (as in innovations like environmental education) and environmental decisionmaking are both practical human activities which take place in a complex, changeable context influenced by political factors and ultimately predicated on value judgments;

* in both educational decisionmaking (the improvements of an environmental education program) and environmental decisionmaking (attempts at resolving environmental issues), candidate solutions are "tested" through the practice of "trying them out" in a specific arena of action. In a way that is fundamentally similar, this practical testing of tentative solutions informs the "actors" (teachers; environmental decisionmakers) about the adequacy of their "theories" (about teaching and schooling; about environmental problem resolution), and about the opportunities and limitations imposed by the arena of action (educational institution; environmental setting). These understanding are generated through a process of critical reflection on the effects of practice.

* an approach to evaluation which actively or passively conceals the complex personal, political, context-dependent (and often idiosyncratic) nature of an educational reform effort like environmental education, and treats it as a purely technical process susceptible to the instrumental testing of intention/outcome fidelity, not only obscures its authentic character, but serves to "disempower"

practitioners and to reinforce the very institutional, political constraints which to date have undermined the improvement of environmental education;

- critical approaches to evaluation resonate constructively with the spirit, character, and intentions of environmental education in that they seek to expose and redress, rather than to obscure and reinforce, the epistemological and institutional structures which operate against environmental education.

Afterword

This paper sought to present an argument for consideration of an alternative approach to evaluation in environmental education, following UNESCO recommendations developed at Tbilisi seven years ago. The alternative outlined here is based on a different epistemology and a different view of the relationship between individual practitioner, the institution she/he works in, and society or culture at large. A question that may well be asked is whether the differences between the outlined approaches amount to mutual exclusivity, or "Can't both scientific/ analytic and critical approaches to evaluation take place within the same program?"

A distinction is often made between formative and summative evaluation. Formative evaluation occurs during the course of the development of a program, and summative evaluation after its completion. Formative evaluation aims at personal and program improvement "along the way"; summative evaluation seeks to gain an overall measure of the worth of the program in retrospect, with a view to discovering some generalizable principles of effective program development for application at other sites. The formative/summative distinction is useful--action research can be seen as formative evaluation (its purpose is personal and program improvement) and certainly makes no claim to be summative in the sense outlined above, whereas scientific/analytic approaches do make such a claim. However, the two approaches are based on different "world views", and the advocates of action research as a kind of formative evaluation are unlikely to see the point of a scientific/analytic summative evaluation. That is, the two kinds of evaluation may well occur with a given program, but they would likely be mediated by the activities of different individuals with different sets of motivations and interests.

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INTERNATIONAL ENVIRONMENTAL CAMPAIGNS: CASE-STUDIES AND ANALYSIS

by

D. Scott Slocombe

ABSTRACT: Environmental campaigns are increasingly frequent and important components of the international environmental conservation movement. In order to facilitate comparison of environmental campaigns, a framework is proposed that includes four major categories: identification, preparation, implementation and evaluation. This framework is used to compare five campaigns: the anti-plumage-trade campaigns of the turn of the century, the World Wildlife Fund's "Operation Tiger", the Club of Rome's unique efforts, the campaign against the Northwest Atlantic seal fisheries, and the International Union for the Conservation of Nature's World Conservation Strategy. The comparison of these campaigns results in identification of some characteristics of successful campaigns and recommendations for future campaigns, such as the World Campaign for the Biosphere.

Introduction

International environmental campaigns are an increasingly common and important part of the international environmental movement. They began as, and have been primarily a tool of environmental non-governmental organizations (ENGO). This is changing: recent years have seen UNESCO's "Man and the Biosphere" (MAB) Program and considerable environmental education efforts by both the United Nations Environment Program (UNEP) and UNESCO.

Rudel (1982) presents an analysis of the division of labor in the environmental movement that appears to support the more frequent use of environmental campaigns by ENGO's than by governmental organizations. Others discuss the campaign activities of some of the more radical European ENGO's (Pickaver, 1983) and Cladwell gives a masterful account of the origins and activities of the major internation ENGO's (Caldwell, 1984). Yet, a comparative analysis of environmental campaigns with the aim of discerning what distinguishes a successful from an unsuccessful campaign has yet to be undertaken.

This paper presents a framework for making such comparisons and applies that framework to five campaigns from the last hundred years: the anti-plumage trade campaigns of the turn of the century, the World Wildlife Fund's (WWF) "Operation Tiger", the Club of Rome's unique efforts, the diverse campaigns against the northwest Atlantic seal fisheries, and the International Union for the Conservation of Nature's (IUCN) World Conservation Strategy. Finally an effort is made to extract lessons from our comparison that are applicable to new international environmental campaigns such as the World Campaign for the Biosphere (Anon, 1982; Davis, 1983).

Framework

One can distinguish four broad categories by which to compare environmental campaigns: identification, preparation, implementation, and evaluation. Each of these categories is further broken down below. None of these levels or categories of description are mutually exclusive. Taken together they are less of a classification than a typology and are meant to guide one's thought to points which might otherwise be missed -- rather like the Leopold matrix for environmental impact assessment.

In order to fully identify a campaign one can use a short descriptive name, the relevant dates, the name(s) of its initiator(s) or their geographic base(s). These characteristics serve to identify the campaign quantitatively (why, when) and qualitatively (by whom, where).

Preparation for a campaign may be seen as defining the campaign's problem (i.e. the issue and its boundaries), the campaign's rationale for intervention (e.g. reactive, preventive, scientific, preservationist), its pre-launch preparation (e.g. duration, types of activities, numbers and levels of people and organizations involved), and its goals (e.g. problem solving, problem management, education, research).

Campaign implementation includes: the form of the campaign (organizational, networking, consultative), the scope of the campaign (geographically, taxonomically), its level of operation (local, regional, state, national, international), the campaign's actors (organizations, governments; the role, numbers and distribution of each), the role of individuals in the campaign (administrative, leadership, celebrity), the resources of the campaign (i.e. financial, professional, amounts, guaranteed or ad hoc), and the methods of the campaign (e.g. action, publicity, research, publication, organizing, education, confrontation, negotiation, participation, leadership).

Finally, one will want to evaluate the campaign in terms of its effects (intended, unintended, compared to its goals, effects on public opinion, establishment of new organizations, new legislations, generation of new knowledge), in terms of adaptiveness to changing circumstances during the campaign, and in terms of follow-up activities to the campaign proper.

The Case-Studies

The five campaigns considered here were chosen for their different goals and settings as well as for being reasonably well known and well documented. The course of each campaign is summarized in a paragraph or two and the main references given; further details, upon which the following analysis is based, can be found in Tables 1 to 5. These synopses are not meant as histories nor are they meant as studies of the political currents that gave the campaigns their form. They are presented in the same spirit that cases are presented in a law or business school, as the bare facts from which the reader should discern the salient points and apply them to other cases.

1. The Plumage Trade

Bird feathers first became popular as a lady's fashion accessory about 1875 and dominated millinery styles after 1880. Many species from all over the world were utilized; but especially over-exploited were the New World gulls, terns, herons, egrets and ibises. In London the Society for the Preservation of Birds (SPB) was founded in 1889; in the United States the American Ornithologist's Union (AOU) became involved in the issue in 1884 while the Audubon Society was first organized in 1886 (and re-organized in 1896). All were mainly concerned with stopping the trade in feathers and plumes.

The U.S. Lacey Act was passed in 1900 and by 1905 thirty-three states had passed complementary legislation dealing with the plumage trade. In 1913 the U.S. Federal Tariff Act, with specific plumage trade prohibitions, was passed. In England the U.K. Board of Trade passed an importation of plumage regulation in 1917 and, finally, in 1921 a Bill on the Importation of Plumage was passed in both Houses. At the same time public opinion had shifted to put feather fashions out of fashion as a result of extensive campaigning by the SPB and Audubon Societies and their members. (Doughty, 1975; Welker, 1955)

2. Operation Tiger

Although the decline of tiger populations had been noticed as long ago as 1940, it wasn't until the late 1960's that serious attempts were made to assess and remedy the problem. Considerable work by Guy Mountfort behind the scenes in Europe and Asia led to the launching of "Operation Tiger" by the WWF in September 1982. In the first eighteen months of the campaign an extensive and innovative public campaign raised 800,00 (US $1.7 million). Scientific research on the tiger was greatly expanded under IUCN's aegis and India (and later other countries) set aside numerous reserves for the species. By 1980, over 40 nature reserves had been established in ten countries and the tiger's population was estimated at 6400 individuals of six races (up from 5000 in 1970). Indeed, recent clashes between tigers and people and livestock in some parts of India raise issues other than simply those of saving the species. (Breeden, 1983; Jackson, 1983; Mountfort, 1981)

3. The Northwest Atlantic Seal Fisheries

Sealing in the northwest Atlantic (primarily for the harp seal) has taken place for centuries. Production peaked in the second quarter of the 19th century and again in the mid 20th century. The hunt was first brought to public attention by a 1964 Canadian Broadcasting Corporation (CBC) documentary. Soon thereafter, Brian Davies, who later founded the International Fund for Animal Welfare (IFAW) around the sealing issue, became involved. In 1976 Greenpeace became actively involved. From the beginning, there was strong foreign media, conservationist, and public interest in the hunt - or in stopping it. 1977 was the year of the protests, Brigitte Bardot's visit, and Paul Watson's debacle on the ice. In 1978 France banned the import of sealskins from the hunt. By early 1983 several other EEC countries (the main market for the skins) also banned such imports. In June 1984 The Canadian Federal Minister of Fisheries and Oceans appointed a Royal Commission to look into all aspect of Canada's sealing fishery. Meanwhile, the Canadian Government was, and is, trying develop markets for sealskins in Asia. While the EEC ban has been important, it may or may not be renewed; what is finally gaining the attention of the Canadian authorities is the reality (in England) and threat (in the U.S.A.) of wholesaler boycotts of all Canadian fisheries products. (Bonner, 1982; Busch, 1985; Coish, 1979; Holt & Lavigne, 1982; Mowat, 1984; misc. press reports)

4. The Club of Rome

The Club of Rome was the brainchild of Aurelio Peccei in the mid-1960's. He joined with Alexander King to organize its founding meeting in Rome in April 1968. There, a handful of people agreed to found the Club of Rome as a "non-organization" of selected individuals:

> concerned with the well-being of mankind as a whole...future-oriented in its thinking...and...necessarily [taking] into account the incongruities of the human condition, its values and goals, both actual and desirable, if the species is to survive. (Peccei & King, 1977)

After two years of globe-trotting and high-level meetings the Club's series of reports on "The Predicament of Mankind" was begun. Today, as Alexander King succeeds Aurelio Peccei as the Club's President, its structure and emphasis may be changing - not too surprizingly, in view of some earlier soulsearching and the changing environmental scene. While the Club's series of reports are highly respected and useful, perhaps a need exists for more emphasis on practical possibilities for change. (Carlson, 1977; Horgan, 1984; Laszlo, 1977; Peccei, 1977).

5. The World Conservation Strategy

Initial discussion of the need for a strategic approach to world conservation took place within IUCN as early as 1969. Plans for the actual development of the World Conservation Strategy (WCS) were initiated between IUCN, WWF, and UNEP in 1975. Four official drafts and various intermediate drafts were submitted to the IUCN membership, nearly 100 scientists and other advisors before the WCS was officially launched -- simultaneously in thirty-five countries -- on March 5, 1980. Today, well over thirty countries are at various stages of evolving national conservation strategies; provincial or state conservation strategies are under way in Canada and Australia, and initial work is being undertaken around the idea of a regional, yet international, strategy for the Great Lakes area. Guides to the development of national conservation strategies have been prepared, as has an introduction to the WCS aimed at decision-makers (Croner, 1984). An international conference on implementation of the WCS will be held in Ottawa, Canada in late May/early June 1986. (IUCN/UNEP/ WWF, 1980; Talbot, 1980; IUCN Bulletin Supplements)

Discussion

All five of the campaigns outline above could be called successful - regardless of what one thinks of the methods used or of the fact that all but one are not over yet. Also, as we shall see, each achieved a different kind of success by following a different kind of campaign.

The campaigns are different, but what is more remarkable are the ways in which the campaigns are similar; it is on this that we shall dwell. Even one hundred years ago, the tactics and the strategy of an international environmental campaign were rather similar to those of a modern campaign.

All the campaigns have lasted ten, twenty, or even thirty years. Although the WCS campaign is but five years old today, it can be expected to continue. Its relatively speedy success can be attributed to the resources and expertise of its initiators.

Except for the seal and plumage trade campaigns, all efforts were originally initiated by people or organizations in the developed western world but included representation from other parts of the world at early developmental states. The two exceptions are campaigns where a truly global approach was unnecessary: in the cases of the seal fisheries (and to a considerable extent the plumage trade) both the harvest and the market were in western countries; in addition, at the time of the plumage trade campaign, organizing in the western, consuming nations was the logical and (feasible) approach. One of the more important changes of the last 100 years, however, is that today an international effort is required to solve an international problem. No single country can today take the lead, as Great Britain did in the first part of the century.

The tiger, seal and plumage campaigns are alike in having a simple, specific problem focus and a preservationist/conservationist rationale for intervention. Typically such campaigns are reactive with little or no pre-launch preparation. They may lack resources (initially and/or periodically) and be slow to achieve full effectiveness. The tiger campaign's early success, like that of the WCS, can be attributed both to the experience and expertise of its initiators and to the lengthy preparation preceding it. The simplicity and ease of expression of the goals of such campaigns are very useful in gaining support for and in the direction and assessment of the campaign.

In contrast, the WCS and the Club of Rome address global, multi-disciplinary situations that not everyone even concedes to be problems. While in both cases the organizations have been able to state goals that are somewhat more specific and practical than their rather general problem statements, the goals have also, in both cases, represented efforts to limit the usual rhetoric of these campaigns. As one might have expected on the basis of their initiators, the rationale of the WCS and the Club of Rome is preventive/scientific and their pre-launch preparation very extensive.

In the long term, a campaign must develop organizational infrastructure. While the launching of a new campaign is greatly facilitated by the backing of an existing organization, such IUCN, WWF or UNEP, individual leadership is critical (cf. Purcell, 1983). Whether one thinks of Brian Davies and Paul Watson in the seal campaign, Guy Mountfort in the tiger campaign, Aurelio Peccei and the Club of Rome or the Duchess of Portland eighty years ago with the SPB, certain people are usually key to the start and continued success of an environmental campaign. Whether they motivate others involvement or organize existing resources, individuals can make or break an environmental campaign.

In looking at the form of the five campaign, we see a progression from the simple education/organizing of the early plumage and seal campaigns through the coordinated international efforts of Operation Tiger and later sealing and plumage campaigns to, finally, the very extensive international networking, coordination and cooperation characterizing the activities of the Club of Rome and WCS. The first step of this progression seems to be simply a natural consequence of the learning experience, perhaps the main result of the early states of any major international campaign. The second half of the progression, however, reflects the changing world scene (from the days of empire to the days of the United Nations), the changing scope of our perception of environmental problems (from threatened species to threatened systems), and the numerous diverse actors in environmental campaigns today (from the upper-middle-class individuals in the past to society-wide concern). These changes reflect the changing political realities of the world , at both an international and a national level, and the basic experience gained in past environmental campaigns. An even more fundamental change may be in the offing as new information and communication technologies become both widely available and accepted; we will then see significant changes in tactics (as noted below) as well as organization.

Modern environmental campaigns, for example, often have surprizingly large resources at their disposal. Even such radical groups as Greenpeace and the IFAW raise large sums of money and find skilled and experience help, while they in turn look with envy (if not occasionally hostility...) at the resource of the IUCN, WWF, or the Club of Rome.

Concurrently with the increase in resources of environmental campaigners, the geographic and political scope of their activities has increased: the anti-sealing campaigns ebb and flow from the shores and ice floes of Newfoundland to the courts and government halls of two continents; Operation Tiger conducts field research and training, and educational publicity campaigns in Europe and Asia; the members of the Club of Rome flit from the public eye to the backrooms of universities, governments and bureaucracies around the world, while publishing what may be the most praised and abused series of reports in history; strategists of world conservation enlist national governments in planning for, and involving people in, ecologically sustainable development at the community level. What sets these varied activities apart from the plumage trade campaigns is more the scale and pace of the activities than their nature. In addition, environmentalism now has professional managers running major campaigns while the amateurs and volunteers provide the manpower. This professionalization is laying the groundwork for a change in the methods of campaigns. Professionals know and love the new information and communication technologies. As technology becomes cheaper and more widespread, these new practices could revolutionize the opportunities for use of information and communication in environmental campaigns (cf. Slocombe, 1984).

I previously stated that all these campaigns could be considered successful. The plumage trade is long dead; the sealing industry is languishing and finally undergoing critical examination by the Canadian government; the tiger is recovering better than many thought possible. The success of these three campaigns is relatively easy to assess. If the Club of Rome and the WCS have not yet achieved much concrete change, they have both resulted in the development and wide dissemination of new ideas and issues with the promise of more to come.

Finally, one must note the adaptiveness exhibited by all these campaigns -- their ability to respond to changing problems and situations both during the campaign and after, most notably in the case of the Audubon Society and the RSPB. These campaigns also made consistent efforts to follow-up on their main activities, e.g. the special IUCN Bulletin supplements dealing with the WCS.

Conclusion

Successful international environmental campaigns are not short-term projects. While simple, clear-cut problems and goals (e.g. stop the seal-hunt) combined with a conservationist/preservationist rationale may simplify the choice of objectives, and method of organizing or fundraising, the future trend at the international level appears to be the other way. The nature of the problems has changed. There will be no simple solutions to acid rain, toxic wastes, the loss of tropical (and temperate) forests, or desertification. Campaigns such as the WCS or the Club of Rome's "Predicament of Mankind" have complex problem statements, multiple goals and a preventive rational. Such intricacies are increasingly necessary in order to move beyond the reactive, consciousness-raising efforts of the last two decades.

Adequate pre-launch preparation is especially necessary for these more recent campaigns. Day-to-day goals involve networking and coordinating at least as much as organization and action. Research and, even more, implementation of the results of research, will be of increasing importance in addressing the complex problems we face.

While there may be some danger of developmenting a high-level environmental bureaucracy, a concurrent continuation of the trend to decentralization of the control and activities of environmental campaigns to all parts of the world exists.

The modern environmental campaign needs a major, preferably dependable, source of resources in order to permit the long-term planning and commitment that is desirable. In order to justify the use of these resources a campaign's initiators must be certain that it is filling a need and filling it well--a little introspection never hurts.

As a modern environmental campaign is likely to combine many activities -- publicity, education, research, lobbying, networking -- at many different levels of different societies, there is a need for good, flexible, adaptive and technically competent management. Complementing these skills, however, must always be a commitment to the goals and methods of the campaign. The diplomatic skills of a good manager will be useful within the campaign itself, between the campaign and other like campaigns, and in mediating between the campaign and its general environment.

One can distinguish between substance (the problems and goals addressed by a campaign) and process (the methods of a campaign) in environmentalism. From this paper it should be clear that in modern environmental campaigns such as the WCS or the World Campaign for the Biosphere, both substance and process deserve careful explicit attention and, indeed, are almost inseparable.

In the blending and intertwining of substance and process into the operational imperative of environmental campaigns, perhaps we are seeing the ultimately more important blending and intertwining of education and action. When education becomes as implicitly and explicitly normative as has the education of today's environmental campaigns, then the divorcing of action -

- the consequences of education -- from the act of educating is more of an intellectual's comforting thought than a useful distinction.

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TABLE 1

The Anti Plumage-Trade Campaign

Identification

Name: Anti Plumage-Trade Campaigns
Date: 1884-1921
Initiators: A.O.U. Committee on the Protection of North American Birds (William Brewster); Audubon Society, (R)SPB
Location: Eastern U.S.A. and Great Britain

Preparation

Problem: The worldwide slaughter of various species of birds for hat ornaments.
Rationale: preservationist/conservationist
Preparation: relatively little; cf. the early failure of the Audubon Society and the lapsing of the A.O.U. Committee from 1890-1985.
Goals: cessation of trade by legislative intervention.

Implementation

Form: organizing
Scope: all threatened species; activities mainly within Europe and North American (but SPB office in India)
Level: state and national governments of consuming countries
Actors: primarily organizations led by strong individuals; in USA Brewster, G.B. Grinnell; in UK Rev. F. O. Morris, Winifred Dallas
Resources: originally small but grew rapidly - many members, most upper or upper middle class, much expertise.
Methods: education/lobbying (pamphlets, model laws) and some action in the form of provision of wardens for sanctuaries.

Evaluation

Effects: Ultimately got the legislation although, especially in the case of Great Britain, styles were also changing by then; increased general wildlife awareness.

Adaptiveness: very good - both organizations changed their methods in response to problems during the campaign.

Follow-up: very good - both organizations have continued and are widely active and respected today.

TABLE 2

Operation Tiger

Identification

Name: Operation Tiger
Date: 1972-
Initiators: WWF and the Indian Government (& Guy Mountfort)
Location: London/Delhi and internationally in the western world and in Southeast Asia

Preparation

Problem: apparent precipitous decline in tiger numbers in India and elsewhere in Asia since the Second World War.
Rationale: conservationist/preservationist
Preparation: extensive organization and consultation prior to launch.
Goals: to raise funds for a program to ensure the tiger's survival

Implementation

Form: networking
Scope: international - fundraising in developed countries and fieldwork in the tiger's native countries
Level: primarily national (with local involvement in field work)
Actors: national governments, WWF, IUCN, universities; role of individuals initially strong, rather less later.
Resources: extensive in terms of both personnel, expertise, contacts and finances
Methods: publicity, research, designation of sanctuaries, local education

Evaluation

Effects: Good - high public awareness, considerable new knowledge, and tiger number up perhaps 60% in last 15 years

Adaptiveness: Not really tested at a macro level

Follow-up: Appears good; cf. Jackson 1983.

TABLE 3

The Northwest Atlantic Seal Fishery Campaigns

Identification

Name: Northwest Atlantic Seal Fishery Campaigns
Date: 1964-1984+
Initiators: Originally the Canadian Audubon Society and many animal protection groups: later, and best known, the International Fund for Animal Welfare and Greenpeace
Location: Vancouver, Toronto; Newfoundland and Europe

Preparation

Problem: a locally important fishery considered needless, inhumane, and non-sustainable by many observers
Rationale: preservationist
Preparation: originally little but by mid-1970's on-site campaigns were well organized and by late 1970's so were the international campaigns.
Goals: to stop the fishery

Implementation

Form: organizing
Scope: one (or two) species in a relatively small geographical area consumed by a relatively localized market.
Level: primarily general public; but later the national and international governments involved.
Actors: ENGO's and the Canadian and Newfoundland governments plus some EEC governments. Individuals - Brian Davies, Paul Watson
Resources: ultimately quite large although always ephemeral as public interest waxed and waned
Methods: publicity, action, confrontation, lobbying

Evaluation

Effects: elimination of most of the markets for the hunt but not without a good deal of negative, as well as positive, publicity

Adaptiveness: good - whatever one thinks of their goals, rationale or methods the latter have certainly been varied.

Follow-up: remains to be seen but IFAW and Greenpeace are generally recognized to be tenacious.

TABLE 4

The Club of Rome

Identification

Name: the Club of Rome Project on the Predicament of Mankind
Date: 1968-1972-
Initiators: A. Peccei, A. King, et al. "The Club of Rome"
Location: Rome - International

Preparation

Problem: the future well-being of mankind as a whole
Rationale: preventive/scientific
Preparation: extensive; four years from inception of the organization to launch of the campaign
Goals: individual and societal changes to ensure the survival of humanity

Implementation

Form: educational
Scope: global and multi-disciplinary
Level: aimed at decision-makers and the informed general public
Actors: Individuals - especially "experts", decision-makers, industrial and business representatives
Resources: officially low; as a result of those involved quite considerable indeed
Methods: research, publication, leadership

Evaluation

Effects: controversial - a lot of publicity and some ground-breaking work but with what real effect?

Adaptiveness: good - both to changing issues and to changing organizational needs

Follow-up: perhaps less good - the club is always moving on to new issues

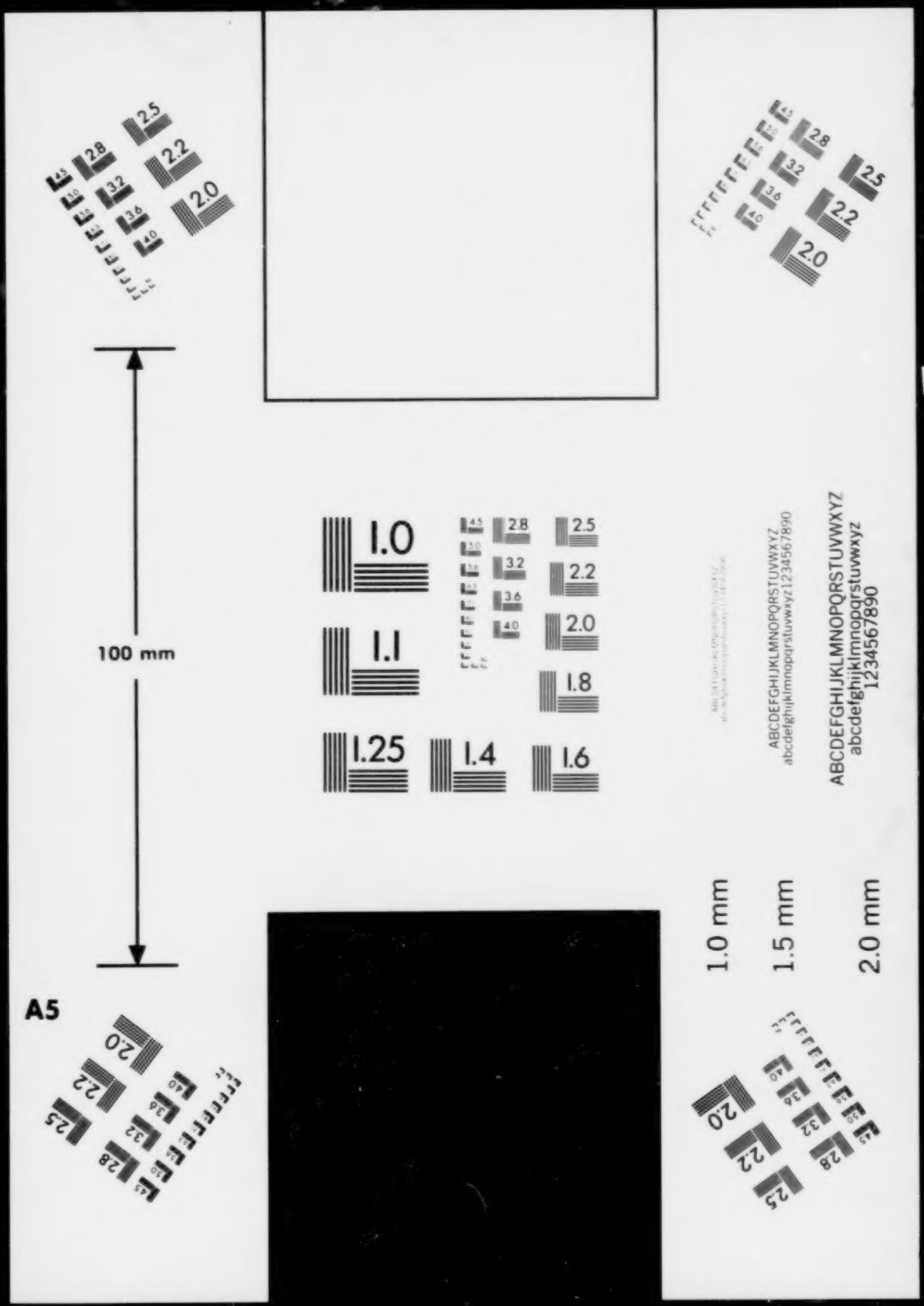
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TABLE 5

The World Conservation Strategy

Identification

Name: World Conservation Strategy
Date: March 5, 1980 -
Initiators: IUCN, WWF, UNEP, UNESCO, FAO
Location: International but coordinated in Gland, Switzerland

Preparation

Problem: meeting basic human needs (development) without irretrievably damaging the environment
Rationale: preventive/scientific
Preparation: very extensive
Goals: "sustainable development"; i.e. maintenance of essential ecological systems and life-support process, preservation of genetic diversity and sustainable utilization of species and ecosystems

Implementation

Form: networking
Scope: global, multi-disciplinary, "biospheral"
Level: national governments; more recently some state governments
Actors: Governments, national and international ENGO's, experts, Role of individuals behind the scenes, e.g. David Nunro
Resources: extensive
Methods: education - planning - participation - leadership

Evaluation

Effects: on paper good; in practice too soon to say. Certainly widespread dissemination of new ideas.

Adaptiveness: good - cf. progressive development of idea of NCS's and PCS's

Follow-up: Good - IUCN Bulletin Supplements, secretariat, conferences and publications

A NEW MOVEMENT IN SCIENCE EDUCATION: EVIDENCE OF ENVIRONMENTAL AWARENESS

by

Peter J. Fensham

ABSTRACT: The reforms of school science curricula in many countries during the 1960s and 1970s were influenced by rather pure or research views of the nature of science. Since 1970 two other influences that are much more social in origin have been pressing for other sorts of changes. These are the Science, Society, and technology movement and the Environmental Problematique. A number of criteria are proposed that could enable science teachers and curriculum designers to know, and other interested parties to check, whether science curricula in schools are responding to these pressing social needs. A comparative analysis of 33 countries' curricula for the primary, and lower and upper secondary schooling levels is reported that makes use of one set of these criteria. It appears that there have been a number of innovations along these directions over the last 10 years in a number of these countries but that this is quite patchy in extent and that there is still much to be done if science education is to contribute consistently to such social responsibility.

I. THE SCIENCE CURRICULUM MOVEMENT

Science curricula for schools at both the primary and secondary levels of schooling underwent a remarkable change in many countries during the 1960s and early 1970s. Beginning in the more developed countries but in due course extending to many developing countries, curriculum projects were set up to modernize the teaching of science and to extend it more universally throughout the whole population of school age children.

Prior to this movement, science in schools had been restricted in many countries to a minority of students who were the elite groups undertaking more academic education in secondary schools.

The new curricula had a number of characteristics. Most, perhaps all of them, emphasized the place of activity or laboratory experience as a much more central aspect of the learning of science. For secondary schooling, many of the curriculum projects set out to bring the content of learning more in line with the current understandings of nature that make the sciences such powerful and significant features of humankind in this second half of the 20th century.

PSSC, Chem Study, and BSCS, in the U.S.A. and Nuffield in Britain, are the household names of the initial projects of this new era and they were adapted or used as influences by many others elsewhere. They were well intentioned, and inspired by genuine desires to share the secrets of science with all. They were largely the products of university scientists, (e.g. in U.S.A., Australia and Thailand) or of their faithful imitators, elite science teachers (e.g. in Britain, Germany, Sri Lanka). Not surprisingly, the theoretical ideas that had such fascination for their creators became the bases of their contribution to science curriculum. There is no need to elaborate these in great detail, for most current science teachers are part of the very few who succeeded, to a greater or lesser extent, in learning this type of new science with its emphases on science concept and principles. In chemistry there were the ideas of bonding and structure, of reaction mechanisms, of classification, of the mole and its special arithmetic. In physics there were wave and particle models, generalizations of forces and their interactions, and the mathematical representations of the relationships between properties that quite transcend the realities of experiences. In biology there were adaptation to the environment, evolution, structure and function, food chains, ecological systems, and genetic logic.

These became the content goals of science education. The thought processes of their genesis and development in the scientific community were, somehow, to become associated with our pedagogical methods of teaching and learning, as well as being complementary goals for science education. Educational theorists like (a) Bruner (1960) with his slogan "the learner in the physics classroom is only different in degree, not in kind, from the research physicist in his laboratory, and (b) Gagne (1968) with his hierarchy of concepts, principles and thought problems, and (c) Piaget (1958) with his ideas of intellectual stages of development, all aided and abetted this supremacy of the thinking or thought aspects of science. "Discoveries" in science and "discovery learning" in science classrooms were associated with these thinking processes in science. (We forgot that they are indeed, "inventions" of humankind, just as are the inventions of technology.) So intellectual processes and discovery in science and in learning were separated from activities and inventions. Science and technology were torn asunder as far as schools were concerned, at just the time when there was a stronger case for "technology" becoming the "applied science" of school (because of its dominance in society) than has probably been the case for most of history. Instead the "applied science" of school became repeating the concepts and ideas of the teacher or text and using simple but abstract rules or formulae in written problems.

There was, in hindsight, a strange arrogance, and naivete too, in our efforts concerning school science education. It was as if we really believed that we could be cleverer than our forebears had been. Historically, there has always been only a tiny handful of people in any society who have been fascinated and interested enough to pursue the "thinking out" or "head" aspects of science, or to advance its knowledge frontiers. Since the 17th century, this minority has enjoyed a special and increasingly privilege status in society, but it has remained tiny in size although elite in character. Indeed, its special position has largely depended on its exclusiveness. A larger number, but still very much a minority, of people have trained in science and become involved in the practical application of scientific knowledge or in its transmission to students in school.

Somehow the designers of science courses for schools convinced themselves that this historical state should be changed and that this sort of "head" science could become the Science of the People. Whole curriculum arguments were built on this view of scientific literacy (e.g. the justification for P.S.S.C. Physics in U.S.A. and Australia, the Web of Life Biology in Australia, the Schools Council Patterns project in Britain, the FUSE projects in the U.S.A. etc.).

A more realistic look at history suggests to me that the mass of society has been attracted to science only when it *did* something for them, e.g. refrigeration, radio, T.V., electronic calculators, transport and communication, etc. When their lifestyle could be altered by the products of scientific knowledge, they became interested, When they could *do* something new or *do* an old thing more easily, they wanted to know about it.

Two decades of the implementation of new curricula have provided a sobering set of evidence, that the attitudes of most of our students to the mysteries of scientific knowledge, like their forebears, have survived essentially unaffected by the flush of enthusiasm of the curriculum designers of the sixties and seventies.*

In the U.S.A. particularly, but also in many Australian Schools, the so-called laboratory-based senior science courses have become what their primary goals always were, knowledge transmission and intellectual process development. The laboratories become less and less used for the acquisition of real practical skills, and in the U.S. are really little used at all

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*See for example, the references in the papers presented at the 1978 Bat-Sheva Conference on Curriculum Implementation and Its Relationship to Curriculum Developments in Science (Tamir *et al*. (1979)

(Fensham 1980). Science knowledge is seen to be in books, and listening and reading and the practice of solving word and numerical problems have become the pathways of learning for most of these science students in both the U.S.A. and Australia.

The fascinated few, and those who wish to compete in society's sorting and selection stakes still persist in studying the sciences that count - physics, chemistry and applied mathematics. These students, in a number of countries, have gone through ups and downs as the rewards of winning - certain jobs and a degree of status - wax and wane with growing unemployment of graduates and over supply of science teachers, engineers, biological scientists, and even of the pinnacle reward of all in many countries, positions in the fields of medicine.

If these basic understanding of modern science were the content emphasis of the new secondary science curricula, the new primary science curricula in the 1960s and 1970s very often emphasized those intellectual processes that were seen to be important in the ways scientists go about their work of extending knowledge and applying it to problems in the physical and biological world (e.g. Science, a Process Approach in U.S.A., Trinidad and Tobago, and West Africa). Natural phenomena were seen to be excellent contexts to develop in young children the basic processes of inquiry, of classifying, of measuring, of inferring, of predicting and of so-called problem solving itself (e.g. in E.S.S. in the U.S.A., Nuffield Primary Science and Science 5-13 in Britain).

Other primary curricula set out to teach, for the first time at this level of schooling, some of the basic conceptual ideas that do have wide applicability in the sciences (e.g. S.C.I.S. in U.S.A., and the New Zealand Primary project).

Throughout this initial development era the separate science disciplines of chemistry, physics and biology (a combination of biological sciences) maintained their distinctiveness when being studied in the years of secondary schooling. The distinctiveness tended to disappear in the new primary curricula since the process skills that were emphasized as goals for learning could be related to phenomena and systems regardless of whether they were usually identified as biological, physical or chemical.

The beginning of the 1970s was characterized by a re-appraisal of the "knowledge" science courses of the 1960s which were already proving inadequate and irrelevant courses of study for the mass of the school, population who by now were staying on for even longer periods of secondary education. The response of the science curriculum designers to this problem of how to offer science increasingly as part of general education was the development of the materials that are familiar in Australia as A.S.E.P., in Britain as Nuffield Secondary Science, and in the U.S.A. as I.S.I.S. and E.S., etc.

Topics and themes tended to be used as the organizing units for science courses. Group activities took over from individual practical experience, and optional choice - exercised by teachers or students - took on a new prominence as to what was to be studied. Attitudinal goals and social experience became important purposes and justifications for science education. Science classes, using these materials, often did lose the bogey reputation that science had had before. Students have reported enjoyment of science. Working with equipment and sometimes even with animals in groups of friends was a pleasant and sociable alternative that many other subjects in the curriculum did not offer. Science teachers were glad not to be always the ones who marked the majority of students down as failures. The list of topics ranged from Mice to Men, and from the Edge of the Sea to Rocks and Minerals. Drugs, Skin and Clothes, Movement, and the Senses were all among the offerings. Where did humans come from? could mean sex or fossil jigsaws, but useful practical skills were still avoided.

The traditional school functions for science of selection and sorting were postponed (but not abolished) in a number of countries. Mathematics quietly did the job that science in the junior secondary years had previously shared. However, it has been found that for many students little knowledge was gained and almost no practical skills were mastered. The numbers continuing on to physics and chemistry in the later years of secondary schools remained much the same or declined, unless they were propped up by mandatory constraints such as university entry requirements. Many of those who did not leave school during the secondary years went on to study only biology, but the quality of their scientific learning (at least in Australia) is increasingly suspect (Blake (1977), Symington (1978)). Furthermore, biology often does not equip them for further tertiary studies in science or even to feel confident to teach science at the lowest levels of primary schooling.

The majority of students, who left school after these sorts of science courses, that we could call "heart" science in contrast to the "head" science described above, may have emerged with some pleasurable memories of their lessons, a few disconnected bits of knowledge, but with no guaranteed practical skills and little scientific literacy in terms of the concepts or processes of "head" science.

Regardless of the level of schooling, the two sets of changes that have just been outlined for science education in schools were reforms that drew their content from analyses of the nature of very pure or academic forms of the sciences. This is hardly surprising since these curriculum projects were invariably in the hands of well meaning academic scientist, successful secondary science teachers or the new breed of science educators (literally spawned by the emergence of the curriculum projects). All of these professionals have socialized in these sorts of science and draw their interests from them and from the problem of teaching them.

Whilst these reforms were being implemented in schools, two other movements involving science were gathering momentum. The first of these is the Environmental Movement which began with individuals in a number of countries recognizing that there was very serious deterioration of the biophysical environment in which civilization and human society exists and on which the more industrialized forms of society increasingly depend for energy, food, shelter and consumer goods. Many of these problems such as atmospheric and water pollution, soil loss, resource destruction, and the endangering of species have arisen from the applications (via new technologies) of scientific knowledge.

The second movement is known as Science and Society, or as Science, Society and Technology (S.S.& T.). This is a two-pronged response to the negative image of science that has developed among many persons throughout the world. Since the 1950s fear of the ultimate unbridling of atomic energy in nuclear holocaust has built up and been continually reinforced as the stockpiles of an ever widening array of new weapons increase and real signs of disarmament fail to materialize. The fact that something like 50% of the world's scientists are employed in developing these fields of military science inevitably associates science with these threats of destruction. By the late 1960s individuals and whole societies were becoming aware of the undesirable side effects of some of the so-called wonder drugs of pharmaceutical science and of the pesticides and insecticides so widely used in contemporary agricultural science. The polluting effects of acid rain and of industrial wastes were getting increasingly publicity and could all be related to technological processes that were associated by ordinary citizens with outworkings of science.

The Environmental Movement and Science and Society (or S.S. & T.) are movements that both recognize that there has been mismanagement of the use of scientific knowledge, and that a much more responsible approach to how science is applied is needed. It is also an acknowledgement that society and all its citizen need to be much better informed and aware of the great contributions that science has made to human happiness and social well-being, and need to be better able to distinguish science's potential for good outcomes from its reputation for evil ones.

This paper reviews the extent to which the ideas and planning for science curricula in schools has moved since 1970, in directions that parallel these two contemporary movements of social concern both of which relate to greater environmental awareness. Some data will also be presented in the final section of the paper that gives some evidence of the extent to which such ideas and plans have been implemented.

II. SOME NEW CHARACTERISTICS FOR SCIENCE EDUCATION

Towards the end of the 1970s and certainly now in the 1980s, there has been a much more informed discussion among science educators about the the Environment, or Science, Society and Technology can mean for teaching science in schools. These discussions have produced new criteria for science education that are evidence of growing environmental awareness.

We can begin to understand the nature of these discussions and their origins if we consider the activities of the Committee for Science Teaching of the International Council of Scientific Unions (ISCU-CTS). The use of the prestigious international body to illustrate the movements being discussed in this paper is only one example that could be used. It is, however, a very important one because of its continuity throughout the period and because it has involved a number of key persons with overlapping spheres of influence.

The first meeting sponsored by this group was a small one in Varna, Bulgaria in 1968 when a number of the curriculum projects of the first wave of science curriculum were still in progress. UNESCO supported the activities of ICSU-CTS as it has done the educational activities of the individual scientific unions that make up ICSU. During the 1960s Dr. Albert Baez was the Director of the Science Education Division of UNESCO and he, through various roles since that time, has been one of th key figures who have assisted very greatly the changing perception of the role science education can and should play.

The second of the CTS conferences was held in Maryland, U.S.A. in 1973, and it was a much larger meeting involving a much wider cross-section of the world's science educators. Although questions of the relevance of science education were beginning to be asked in the early 1970s and the UN Conference on the Human Environment had been held in Stockholm in 1972, the agenda of this second CTS conference was set a year or so earlier. Its major concerns were focused on the education system itself and on the possibilities of an integration of the sciences and how such integrated science could and should be implemented in science curricula. There were workshops on elementary and secondary integrated science education, on the curricular resources that are needed, and on the preparation of teachers for such science teachings.

In 1974 under the leadership of Professor William Stapp (University of Michigan) the UNESCO-UNEP Environmental Education Project began - a direct consequence of the Stockholm Conference at which the Environmental Problematique was recognized internationally as urgent and global. This project convened international (Belgrade and Tbilisi) and regional meetings during the next four years. At these, many of the science educators who had met earlier at Maryland found themselves representing their subject in an atmosphere in which the unbridled application of science and technology was held responsible for many of the world's environmental problems in which a better understanding of their subject was seen as an essential ingredient in the resolution of these problems.

By the time the next CTS conference was held in Nijmegen, Holland, in 1978, the science education movement was, at least among many of its leaders, well aware of these challenges from the environmental movement. While a number of the workshops at the Nijmegen conference maintained the inward focus on the educational system that had been dominant at Maryland, a number of other workshops gave serious consideration to the challenges to science education and to its curricula from society outside the school. Among these challenges were those more complex transnational issues that are so important for the global environment. These issues also affect the development of that majority of the world's population who do not enjoy the quality of life that is associated with those countries where scientific leadership (such as those prominent in ICSU) is concentrated.

About ten of the group at Nijmegen who joined the workshop on Science Education and the Environment had been at Tbilisi the previous year and they decided to see if they could turn some of the major characteristics of environmental education into a set of criteria to guide science educators who were seriously interested in relating learning in the sciences to this part of the issue. The outcome of the workshop has been reported by Fensham and May (1979) and the set of characteristics is listed in Table 1.

If applied in the classroom, these characteristics could enable science teachers to teach almost any science curriculum so that it did make a contribution to environmental education. Of course, if the curriculum itself or its accompanying materials do

TABLE 1

CHARACTERISTICS OF ENVIRONMENTAL SCIENCE EDUCATION

1. Environmental Science Education (ESE) is oriented toward a problem.
2. ESE is concerned with realistic situations.
3. ESE aims to elaborate the alternatives that exist for situations and the skill of choosing between them.
4. ESE includes action as an integral component.
5. ESE uses the real environment of the school and its surrounding as a context.
6. ESE involves the clarification of values.
7. ESE aims to increase the ability that students have to contribute to improving their own environmental situations

explicitly include environmental topics, that makes the task easier for all science teachers.

Probably because of the author's involvement in the Asia Region's part of the UNESCO-UNEP Project and because of his place in international science education, he was asked by UNESCO to produce the experimental module (UNESCO, 1984) of units for use in the training of science teachers so that they will be equipped to make the sorts of contribution to environmental education outlined above.

In the post-Nijmegen period, the members of the CTS committee were increasingly made up of persons who had been involved in the Science and Society movement in the 1970s - or in the environmental one described above. Chisman (for CTS) and Gardner and Haggis (for UNESCO) were particularly important links for science education that stretched back to the Varna meeting. Kelly, Lewis and Waddington are key contemporary members and science educators whose outlook is very much to society. It was not surprising then to find the fourth CTS conference taking as its agenda, a series of workshops that were about the relation between science education and the society outside of education. Nine aspects were chosen - Health, Information Transfer and Technology, Food and Agriculture, Environment, Industry and Technology, Energy Resources, Land, Water and Mineral Resources, and Ethics and Social Responsibility.

Baez, who had been chairman of the Education Commission of the International Council for the Conservation of Nature since 1980 (after Stapp), was asked to lead and plan the Environment Workshop. A number of others who had been part of the interactions outlined above now had key roles in relation to many of the other workshops (leaders, pre-conference paper writers, facilitators, etc.) In order to be at Bangalore they would almost all have had to have some capacity to influence science education in their own countries. A number have been engaged in planning the newest wave of science curricula for schools.

The close relationship of these workshops topics to the broad areas of concern identified by the UNESCO-UNEP project is no accident, as I have tried to describe in this account.

Population, Food Resources, Energy, Ecology and Ethics, as one formulation listed them, are all areas that have many sub-topics that could be treated within the curricular content of science courses at school. Nor has it been difficult for curriculum designers in international workshops to devise apparently excellent units of curriculum which suggest details for these sub-topics. The curriculum workshops under the leadership of the Asian Programme of Educational Innovation for Development (APEID, 1980) are outstanding examples of this international co-operation in curriculum development. It is, however, rather ominous that after 10 years of APEID activity, one finds that the UNESCO Regional Office for Education in Asia and the Pacific is preparing a new set of initiatives now entitled SCIENCE FOR ALL (APEID, 1983). The need for this latest programme is the very evidence that indicates that it has turned out to be much harder to implement substantial change in the science curriculum of a national system of education than it is to develop exemplary curricula outside of the constraints of real situations.

This is not to say that interesting innovations are not occurring. In the final sections of this paper evidence will be presented that suggests there is movement in practice and some examples will be presented. Developing countries in Asia appear to be at least as well represented in these innovations as are countries elsewhere.

One other example of how curriculum ideas flow across national boundaries will be given because the origins in this case are very clear, and because it was a meeting where the influence of science educators from developing countries was much more articulate and leading than is usual at international meetings.

In 1982, the Commonwealth Office in London convened a small workshop in Cyprus of curriculum experts from the fields of science, mathematics and technology. Among the science educators, Chisman and the author provided links to the ICSU-CTS network, but most of the others were from African, Asian or Pacific countries of developing rather than developed character. The comparative absence of first world representatives enabled the voice of other experiences and needs to be well heard and their contributions were very valuable. As little of this experience is easily available in the international literature, I was struck by how over-dominant ideas from the print of the first world are because these printed reports then determine speakers at conferences who tend to repeat what they have written, etc.

The group in Cyprus set themselves the task of concentrating on science education that could be justified as worthy of being part of the learning of all students before they leave school whenever that may be for a given society. Two criteria were established for knowledge to be of worth for these total school populations. These are (A) that learning this knowledge would have a good chance of enhancing the quality of the learners' lives outside of school - at home and in society - not too long after it is learnt, and (B) that the learning would excite most learners with wonder and a sense of curiosity about the natural world.

A list of key topic areas was produced within each of which, the members of this small workshop had been able to give illustrations of possible learning (knowledge, skills and processes) that met, in their own society, one or other of these criteria.

The list of key topic areas is given in Table 2.

Two examples of how these topics had to be justified are the following, although this justification had to go on to more details for actual suggested learning topics.

Topic 1 Human beings explore the world around them through their senses. The use of these senses and technology related to persons to make a record of the world around them.

Measurement is a way human beings compare and communicate about object, phenomena, space and time. There are many measuring instruments in existence that form part of our civilization. Measurement both extends our senses and overcomes limitations of them.

Topic 10 Efficient use of energy resources is a pressing personal and social need everywhere. All countries need to lower their dependence on imported energy resources and to reduce wastage. Understanding of efficiency in energy use can lead to an enhanced quality of personal and family life.

These examples of the generation of curriculum ideas and particularly of how environmental awareness and concerns move in to science education could, I feel sure, be multiplied for other national and international networks some of which would almost certainly interact with the ones described here.

It is now time to turn in the final sections to the extent that these ideas are yet influencing practice.

III. APPLYING THE CRITERIA OF SOCIAL RELEVANCE

The answer that will be given to the question, "How relevant are the new school science curricula?" will depend on the criteria with which we judge relevance. There are many criteria for science curricula. The dominant criteria in the 1960s and early 1970s were drawn from inside science itself and the relevance (in those senses) of many curricula for schools across the world was greatly improved for those few who could

TABLE 2

KEY TOPICS FOR A BASIC MINIMUM CORE OF SCIENCE EDUCATION IN SCHOOLS (CYPRUS WORKSHOP)

1. The senses and measurements as extension of the sense.
2. Our universe
3. The human body
4. Health, nutrition and sanitation
5. Food
6. Ecology
7. Resources (natural and man-made)
8. Population
9. Pollution
10. Energy use
11. Technology
12. Quality of life

successfully learn that sort of science and who wished to have the option of moving on to a career in the science-based professions (Fensham, 1985).

In the later 1970s and in the 1980s other set of criteria have become clear as I have indicated above. These relate (i) to the content areas from which science topics can be drawn, (ii) to the ways in which real situations and practical skills (useful in the real world outside school) can become the foci for learning in science and (iii) to the sorts of understandings, concepts and intellectual skills for solving environmental problems, that science education is particularly well able to assist.

These are criteria that stem from the acknowledgement (from the science side or the society side) of those great interfaces, Science and Society or Science, Society and Technology (SST).

Blum (1981) surveyed many science curriculum projects in the USA and found that a significant number appeared to be examples of Environmental Science Education (ESE). He found that more science education programs fell into the ESE category in 1977 than in 1974. The dominant environmental topics prior to 1974 were conservation of nature, use of resources and improvement of quality of life, whereas by 1977 ecology and use of energy were in the forefront. Water and air pollution were commonly included as sub-topics in these projects' materials but nuclear pollution was only rarely present.

Many other science curricula in the USA and elsewhere do not score at all well as ESE or as examples of SST. It is, on the other hand, possible for me to point to curricula for science education that do measure up well on these social or environmental sorts of criteria. The Science and Society subject (England) and Physical Science - Man and the Physical World (Australia) have both been publicized through the Newsletter of ICSU - CTS (No. 7, No. 8).

The materials for the two senior science courses provided many opportunities for their teachers and students to study environmental issues in depth. The scientific basis of these issues is the primary focus, but social, economic and political issues are also encouraged rather than avoided. The encouragement extends to that critical determinant of worth namely, the examination paper. Thomas (1985) has presented a brief account of the lessons he and his colleagues have learnt about how to examine the multi-faceted aspects of Science and Society learning in the Physical Science course in Australia. It should be noted, however, that both these two senior secondary courses are only studied by a very small minority of the students taking science at these levels in their respective countries.

They remain as substantial symbolic examples of how science education might be, rather than as examples of how the mainstream of science education has changed.

Similarly, a number of curriculum units for possible use in science courses have been produced at the IPN centre in West Germany that include much that meets these social and environmental criteria. Millar (1981) has provided a useful account of the physics material from this institute. Even more sharply than in the cases just discussed, the question arises as to how widely these materials are or can penetrate the teaching of the sciences in the lände (states) of the Federal Republic. Indeed, Millar compares the origins of these curricula with British science curricula in general and advances a "social control" model to explain why a much stronger science and society emphasis has emerged in the German materials. There is by no means a direct link or easy acceptance between the production of materials at IPN and their incorporation into any official curriculum for German schools.

It is interesting to note that the role of examinations in determining this sort of content for science education has been taken up in Kenya where there is a strong requirement that questions testing science learning should be set in real life, social and technical contexts, and in England where at least 15% of al external science examinations must be on "social, economic applications".

Some interesting examples of new science education that sits on either side of this "social control" edge have emerged recently from the PLON group in the Netherlands. This physics curriculum group has been active for a number of years in the Science, Society and Technology dimension. A very noticeable compilation of their curricular proposals is now available in England under the title Physics in Society (Eijkelhol et al.,(1981)).

Even more recent from this same source are two curricular units for students in the senior levels. One of these, Ionizing Radiation, is now part of the core for the final year at school. It deals, as the title suggests, with a range of ionizing radiations and their properties and effects in society. This unit lies on the acceptable side in the Netherlands of social control. The other unit, Nuclear Weapons and/or Security, lies on the other side at this time and remains as an optional unit which teachers with their students may wish to undertake. It to contains much physics but this physics is not there because it is the basis for this societal phenomena that has aroused great controversy and public interest in Europe over the last decade.

A strikingly contrasting situation now exists in the USA with the publication "Educating Americans for the 21st Century". Apart from the jingoistically offensive and meaningless subtitle about being a plan to make American students the best in the world re science education by 1995, this report from the National Science Foundation (1983) moves the science education debate back towards 1957 and away from both Science, Society and Technology and the environmental challenge. Social control now takes as its locus the struggle for world supremacy in technological and economic development. In 1957 America saw the USSR as their competitive threat. Now Japan threatens and it is their comparative educational achievements that are set up as yardsticks. Given the movements I have described in the first two sections of this paper, and the way in which Science for All is currently being addressed in other countries, it seemed inconceivable that any responsible body in science education could have discussed the task before it without references to the environment. As Lubbers (1984) had pointed out, the inconceivable has occurred in this important national report.

A number of other examples of secondary curricula now have, in varying degree, the characteristics that the two social movements of this paper require. The Philippino course, Chemistry in Our Environment, includes such applied topics as (i) making a water-sealed toilet, (ii) the thermal and chemical effects of geothermal energy and (iii) charcoal production with less air pollution. Likewise, new chemistry courses are being introduced in Zimbabwe (Chemistry and Industry) and the U.S.A. (Chemistry in the Community). In the light of the NSF report's emphasis for science education in the USA it will be important to monitor how successfully the latter course spreads in the next few years. The General Science course (lower secondary) and Physical Science course (for senior secondary students not specializing in science) in Thailand ensure that some science education with social relevance is part of the education of all students in that country.

Examples of curricula for primary or elementary schooling, also known by the author to have some of the elements that these social criteria require and that are widely used, would be those for primary children in Sri Lanka and Thailand. At the primary level, science finds its place in these countries in Environmental Studies or in Life Experience Studies.

The Working in Science (Britain) and the Individualized Studies in Science (ISIS, USA) are curriculum materials with similar qualities for the less academic students in the senior secondary schools of those countries. Some alternative courses in senior chemistry (e.g. ALCHEM in Alberta, Canada) have also appeared in recent years with an increase in emphasis on social applications and environmental issues. However, with these examples it is important to note that they are by no means mandatory and may be studied by only a minority of students in these countries.

In addition to a whole curriculum for a given level of science education in schools, there are now (compared with 1970) a great number of sources in many countries of charts, texts, leaflets, booklets, lists, games, etc., that teachers can tap if they wish to move their regular science classes in the direction of the social criteria. The government Departments for the Environment, the international agencies like the International Union for the Conservation of Nature, non-government agencies like Friends of the Earth, etc., and a number of industrial companies, are all now much more willing and active in collaborative development of curriculum materials for these sorts of science education.

IV. ESTIMATE OF CHANGING SOCIAL RELEVANCE

Readers in other countries will no doubt know of many other curricula in their own countries and it must be left to them to apply the criteria above and so answer the question of how relevant they are for themselves.

In an attempt to make such estimates of how science curricula are changing in these directions of social relevance, I sought the opinions of science educators in forty different countries. The results of this survey which sought estimates of change in the experienced curricula from 1970 to the present are presented below. In reading them it is important to remember that they are only the "armchair" estimates of the science educators who were asked simply to estimate from their experience these changes. They are not the findings of detailed evaluations of either the content or the classroom experiences of the students in the various countries.

The criteria used for this survey were sub-topics drawn from the broad environmental and SST topic areas that have been outlined above. Table 3 lists the sub-topics of the curriculum for which information about changing emphasis was sought.

Responses have now been received from 34 countries (an excellent response rate of over 80%) with at least 32 commenting on each of the three levels - elementary or primary, lower secondary, and upper secondary - for which survey sheets were provided.

There is good coverage of Asian countries, the Pacific, Europe (excluding Eastern Europe), Anglophone Africa and North America. This does leave some obvious

TABLE 3

The Sub-Topics of the Survey of Changing Environmental Awareness of Science Curricula (1970-84)

FOOD AND POPULATION

1. nutrition in relation to health (not just food science)
2. causes of disease and illness among humans
3. population control
4. population issues in relation to those of food supply
5. health of the human body
6. effective use of water in agriculture
7. water as a key ingredient for human health

RESOURCES AND ECOLOGY

8. consumption and conservation of living resources
9. consumption and conservation of non-living resources (minerals and fossil fuels)
10. the place of human beings as integral parts of, and interactive contributors to, the ecology of biophysical systems
11. critical conditions of threatened biological species
12. how science contributes to better quality of life

ENERGY AND INDUSTRIALISATION

13. more efficient use of energy
14. alternative renewable sources of energy for use (solar, wind, tidal, etc.)
15. advantages and disadvantages of nuclear sources of energy for peaceful purposes
16. scientific aspects of nuclear armaments and the risks of nuclear war
17. varieties of pollution and pollution control associated with industrialisation
18. preservation of features of human historic heritage

TECHNOLOGY AND SOCIETY

19. technology in society at large
20. technology affecting student as individual
21. interaction of science and society
22. instrumentation and measurement
23. how computers are changing the nature of scientific work

regional gaps and there is a need to try to cover these in the future.

The information sought was whether there had been a "change in student learning experiences", from 1970 to 1984, in relation to each of these sub-topics that might be included in science curricula at the levels of schooling covered by the primary, lower secondary and upper secondary years. The respondents were asked to estimate the extent of change as definitely more, probably more, probably less, or definitely less with not sure or no change as other alternatives. These data, thus, do not indicate the actual amount of the curriculum devoted to a given sub-topic. A no-change response often meant that the sub-topic area does not have a place in the curriculum (1970-1984) and sometimes that its place has not altered in this period. Furthermore, a number of not sure responses were due to the science educators not being fully familiar with all the details of the curriculum. Again, such a response does not necessarily mean that the particular sub-topic does or does not exist within the learning experiences of the students in their countries.

The respondents are likely to have used rather different subjective estimates of what constitutes a definite change. However, all of them have made use of several of the categories of response for the range of sub-topics so that they were able to discriminate between perceived amounts of change, except where they were not sure about a particular sub-topic.

There are a number of methodological aspects of such an international survey. One is the choice of respondents from among known colleagues in science education. My previous experience from two earlier attempts at international surveys is that formal sources such as ministries of education are poor sources of data. The response rate is low and such respondents, not surprisingly, tend to interpret and to respond to standard questions only if they can make them fit their existing particular data base or system. Known colleagues, on the other hand, do respond usually and they, as in the present case, are often willing to seek out others in their system to answer about a level of schooling about which they were not familiar or confident.

The second methodological aspect is the reliability and validity of the respondents' assessments. In a number of cases two or three respondents in the same country were approached independently. Discrepancies did occur in these assessments and the results are an "averaging" of the two estimates of perceived change about a sub-topic. Very often these differences were only one ranking out of five apart. Different rankings are not surprising in those countries, like USA, Britain, Australia, Canada, etc., where there is no central national curriculum and the experience of "most students" is something that can only be reported for a regional level unless the various regions have all changed their curriculum in the same direction. Because of this two Canadian respondents from different provinces were treated as if they were from different countries.

The responses from 33 countries to each of the survey's items are given for the three levels of schooling in an Appendix at the end of this paper.

Only one country reported a lessening of the learning experiences for a large number of these sub-topics. All the other countries reported movement towards more experiences for many of the sub-topics at least at two of the levels. In a number of countries there has been no change in the formal science curriculum at one of the levels since the late 1960s but in some of these, reviews have begun, which it was reported, are likely to lead to the inclusion of some of the topics.

There is, however, not one sub-topic among the 23 in Table 3 for which more than 50% of the respondents reported a definite increase at any one of the levels of schooling.

At the primary level four sub-topics (22, 8, 1 and 5) received the highest number of definitely more responses. At the lower secondary level the leading four sub-topics were 9, 22, 13 and 1, while at the upper secondary level they were the three sub-topics, 8, 9 and 17. Nutrition (1), consumption and conservation of living resources (8), and instrumentation and measurement (22) are suggested thus as the areas of most change. However, the response definite change has probably been used differentially by the respondents and so two other criteria of significant curricular change have been applied to the data.

The more conservative one is that two thirds of respondents should indicate definite or probable increase in the learning experiences. The more generous one is 50 percent of the respondents saying definite or probably increases.

Application of these two criteria to the data in the APPENDIX separates out those topics where a fairly widespread shift in science curricula towards SST or environmental issues has most probably occurred since 1970. The results of these tests are given in Tables 4 and 5.

Four out of the 23 sub-topics are reported as increasing at each of the three levels by two-thirds of the country respondents and another 10 are in this

TABLE 4

SUB-TOPICS FOR WHICH TWO-THIRDS OF COUNTRY RESPONDENTS REPORT SOME DEGREE OF INCREASE IN LEARNING EXPERIENCE BY LEVEL OF SCHOOLING

	Sub-Topics
Primary	22, 13, 14, 8, 9, 1
Lower Secondary	19, 21, 13, 14, 8, 9, 1, 10, 17, 11, 5
Upper Secondary	19, 13, 14, 15, 8, 9, 10, 17, 11, 23

TABLE 5

SUB-TOPICS FOR WHICH 50% OF COUNTRY RESPONDENTS REPORT SOME DEGREE OF INCREASE IN LEARNING EXPERIENCES BY LEVEL OF SCHOOLING

	Sub-Topics
Primary	19, 20, 21, 22, 13, 14, 8, 9, 1, 2, 4, 10, 17, 5, 7, 23
Lower Secondary	19, 20, 21, 22, 13, 14, 15, 8, 9, 1, 2, 3, 4, 10, 17, 11, 12
Upper Secondary	19, 20, 21, 13, 14, 15, 8, 9, 1, 2, 3, 4, 10, 17, 11, 5, 12, 23

category if the lesser criterion of only 50% of country responses is used.

Energy use (13, 14) and conservation of resources (8, 9) are thus now being considered by teachers of science and their students fairly commonly and these sub-topics are joined by others associated with nutrition (1), population health (2, 3, 4, 5), pollution (10, 17) and technology (19, 20, 21) in a good many situations. The presence of the sub-topics at each of the three levels means that all students at school, and not just those specializing in the senior sciences, are involved.

Among the respondent countries there are 16 which would probably be described as "developed" in the industrial sense and 17 that are "developing" in this sense. It is interesting to consider whether the curricular changes that have just been described here seem to be occurring more readily in one of these groupings. Overall, the results of this further analysis show few differences in the trends and tend to confirm that movements in the curriculum of science education are international in character as the earlier sections of this paper suggest.

For the four sub-topics that show the greatest evidence of increase at all levels, the percentage of positive responses were 80.7 and 75.1 for "developed" and "developing" countries respectively. When the other 10 commonly increasingly, sub-topics are considered the corresponding values are 67.9% and 71.0%. Over the 14 sub-topics, 71.8% for the responses from "developed" countries compare very closely with 72.2% from the "developing" ones.

Other comparisons can be made and some single sub-topics do show some rather larger differences but the samples are too small to place much significance on such a difference when the overall picture is so similar. From level to level there is also remarkable constancy (71.1%, 71.4%, 72.5%) in the "developed" group. In the group of "developing" countries the values of 64.1%, 81.3%, 71.2% may suggest, rather surprisingly, that more attention has been paid to these social dimensions at the lower secondary level than at the primary level, but this may be a reflection of the fact that science education in general has not yet been fully established in primary schooling in these countries.

The lowest penetrations of the curriculum are reported for sub-topics 16, 18, 6 and 7. These gaps are serious ones and the more so because there is much public debate about them in many countries. Acid rain and other types of atmospheric pollution are rapidly destroying the facades of historic buildings and other heritage treasures in most industrialized cities (18).

This is evident for students to see, the chemistry is relatively simple, and action by informed citizens could do much to institute controlling legislation.

The loss of arable land through shortages of water or inadequately controlled use of irrigation is very serious in many countries (6). Likewise the pollution in water supplies is worsening rather than improving on a world scale (7).

Finally, it is disturbing to find that only a few countries (33% "developed" and 37% "developing") have incorporated sub-topic 16, the scientific aspects of nuclear armaments and the risks of nuclear war - the source of what would be the greatest environmental disaster of all were a nuclear war to break out. Even at the upper secondary level neither exceeded 50% positive responses. If these most senior of science students were gaining knowledge about these issues more widely , the efforts of those who are trying to bring about peace and more constructive use of the vast economic, human, and other resources involved in this arms race would be made easier.

The findings reported here if they do reflect actual changes in the learning experience of students are both encouraging and sobering. They do indicate considerable change towards greater environmental awareness in science curricula. However, on the toughest criterion of 50% reporting a definite increase is used, it has been sobering indeed to learn that not one of these sub-topics has been incorporated that widely into the curricula at any of these three levels. There is much still to be done for the environmental and the Science, Society and Technology movements through school science education.

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APPENDIX

Reported Changes in Learning Experience in Sub-Topics for Science Curricula at Three Levels of Schooling

(Each quartet is the number of responses for definitely more, probably more, probably and definitely less, and not sure or no change or none)

Sub-Topic	Primary	Lower Secondary	Upper Secondary
1.	13, 11, -2, 7	13, 14, -1, 6	10, 11, -2, 10
2.	8, 10, -5, 10	11, 8, -1, 14	8, 11, -1, 13
3.	3, 11, -5, 11	8, 14, -2, 10	9, 12, -3, 9
4.	4, 12, -5, 11	8, 13, -2, 11	6, 14, -1, 12
5.	13, 8, -4, 8	12, 10, -2, 9	6, 15, -2, 10
6.	5, 2, -3, 23	7, 6, -4, 16	4, 7, -5, 17
7.	5, 12, -3, 13	10, 6, -2, 15	4, 9, 18, -2
FOOD AND POPULATION			
8.	13, 13, -1, 6	14, 16, -1, 3	13, 12, -1, 6
9.	5, 10, -1, 7	12, 17, -1, 4	14, 9, -1, 9
10.	4, 14, -4, 10	7, 17, -2, 8	9, 13, -1, 10
11.	1, 13, -6, 12	5, 18, -2, 9	5, 17, -3, 8
12.	6, 10, -5, 12	9, 10, -3, 11	7, 12, -2, 12
RESOURCES AND ECOLOGY			
13.	10, 14, -1, 8	13, 13, -1, 7	9, 15, -1, 7
14.	7, 15, -1, 10	10, 16, -1, 7	10, 13, -2, 8
15.	1, 10, -2, 20	6, 11, -3, 14	7, 15, -2, 9
16.	0, 8, -2, 23	2, 7, -2, 21	4, 12, -4, 13
17.	6, 14, -5, 7	13, 14, -2, 5	13, 14, -1, 5
18.	2, 9, -5, 17	3, 12, -2, 16	5, 8, -2, 18
ENERGY AND INDUSTRIALIZATION			
19.	5, 13, -2, 13	14, 11, -2, 7	10, 13, -2, 7
20.	5, 14, -3, 11	10, 10, -2, 12	8, 11, -1, 13
21.	7, 14, -1, 13	10, 18, -1, 5	9, 12, -1, 11
22.	12, 13, -1, 7	14, 5, -4, 11	7, 9, -10, 7
23.	8, 9, -2, 14	9, 6, -2, 16	12, 11, -2, 8
TECHNOLOGY AND SOCIETY			

ENVIRONMENTAL EDUCATION CURRICULUM MATERIALS: DO THEY REFLECT THE CONTEMPORARY RHETORIC?

by
Robert B. Stevenson

ABSTRACT: A number of authors have noted a discrepancy between internationally accepted objectives for EE and the objectives emphasized in school programs in both the United States and Australia. Curriculum materials usually serve as the major resource for teachers planning instructional activities. Therefore, a content analysis was conducted for several commonly used curriculum packages from both countries to examine if they reflected the international rhetoric. The results revealed a high degree of consistency on objectives related to the development of conceptual understandings about the environment and to the development of skills for environmental investigations. A lesser, but still reasonable, amount of compatibility between the materials and the rhetoric was evident in relation to objectives concerned with attitudes and values. However, very little or no attention was paid in the materials to the action dimension of EE. A theoretical perspective on the reasons for such a significant omission and the implications for fostering the practice of action-oriented EE in schools is advanced.

ACKNOWLEDGEMENTS

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The Theory-Practice Dilemma

A number of authors have noted a discrepancy between inter-nationally accepted objectives for environmental education, as expressed in the Belgrade Charter and the Tbilisi Intergovernmental Conference Report, and the objectives emphasized in school programs in both the United States (Childress, 1978; Hungerford, Peyton & Wilke, 1980) and Australia (Robottom, 1982). For example, Childress concluded from his study of 301 environmental education programs and projects that knowledge of the environment and associated problems and an appreciation of environmental resources were emphasized in a majority of schools rather than problem solving skills and the actual solution of environmental problems. Yet the Tbilisi Report recommended five categories of objectives for environmental education, including skills--"for identifying and solving environmental problems"--and participation--"to be actively involved at all levels in working toward resolution of environmental problems."

This apparent inconsistency has been attributed in part to "the inherent difficulties confronting a curriculum developer charged with the task of translating what are actually general goals into manageable instructional objectives" (Hungerford, Peyton & Wilke, 1980). Consequently, these authors developed four levels of intermediate or sub-goals (comprising 28 statements in all) to provide a more specific focus for curriculum planning. On the other hand, Robottom (1982) proposed that the discrepancy can be explained by teachers' dominant presuppositions (often subconscious) about knowledge, teaching and schooling. These presuppositions include: (1) knowledge is discipline-based, objective, and value-free; (2) teaching is the authoritative imparting of factual information which is manifested in a didactic approach to instruction with an almost exclusive reliance on texts and other second hand data sources; and (3) the purpose of schooling is the socialization of students and the maintenance of the existing social order. Such generally-held presuppositions, argued Robottom, are highly consistent with an emphasis on the knowledge or informational dimension of environmental education, but conflict with a problem-solving and action orientation.

Role of Curriculum Materials

Curriculum materials, when available, frequently serve as the major resource for teachers involved in curriculum planning for innovative programs or activities. Dependence on such materials is likely to be accentuated when the innovation: (1) is not delineated in recognized textbooks; and (2) is not linked to a single subject area in which teachers have established expertise, but requires understandings and techniques drawn from a number of disciplines. This is the situation that applies to environmental education in elementary and secondary schools.

Many curriculum development projects were mounted in the United States during the 1970's to provide materials that would assist teachers to develop appropriate environmental education programs and activities. Typically the resulting materials were multi-grade, multi-disciplinary, and contained: specific instructional objectives; suggested classroom and field activities (sometimes in lesson form); an overriding conceptual framework around which the activities were structured; and lists of useful resources. Such materials are intended to leave teachers with few curriculum and instructional decisions. In fact, the traditional research, development and diffusion model which these projects generally emulated presumes the role of the teacher as being the manger of the developers' instructional ideas. In other words, the underlying assumption of this model is that the materials will be implemented in the manner conceptualized by the developers who obviously seek to influence classroom practice in accord with their own conception of environmental education.

Given this assumption, it is appropriate to examine whether curriculum materials reflect the international philosophy of environmental education: an initial condition for establishing a congruency between theory and practice in schools. However, if an analysis of the materials should reveal consistency with the rhetoric, then it cannot be immediately assumed that their use will ensure emphasis of the same objectives by schools.

Analysis of U.S. Materials

Four set of North American environmental education materials were selected from a small number nominated by two environmental educators who were familiar with materials that had been prominent in schools up to 1981. Only curriculum materials that were multi-grade, with secondary grade levels included (e.g., K-12, 7-12), and inter- or multi-disciplinary were considered.

A content analysis of these four sets of materials was carried out using the 28 sub-goals statements developed by Hungerford, Peyton and Wilke as the criteria for evaluation. These statements, which were published subsequent to the development of all the materials analyzed, had been validated by the authors against the five Tbilisi categories of objectives (or more accurately, general goals). Each set of materials was closely examined for statements of objectives and a conceptual framework that could be compared with the 28 sub-goals. Then activities were reviewed to further ascertain the objectives implied by their content and suggested instructional strategies. Thus both stated and implicit objectives were considered in analyzing the intentions of the particular materials.

It is acknowledged that desired objectives may be achieved by a skillful teacher with almost any curriculum materials--or none at all. Nevertheless, the use of some materials is more likely to lead to the attainment of certain objectives than the use of other materials. In conducting the content analysis, responses were made on the basis of whether the listed criteria were likely to be satisfied by virtue of the materials as they stood. Obviously this required, in most cases, a subjective judgment. Consequently the use of a panel of experienced environmental educators to undertake the same procedure and establish a reliability measure for this analysis would have greatly strengthened the study. Unfortunately the substantial amount of time required to complete the analysis of these comprehensive sets of curriculum materials precluded the involvement of such a panel.

For the purpose of this study the five Tbilisi categories of objectives were slightly reorganized with "awareness" and "knowledge" combined into a single knowledge category, and "skills" split into two categories of skills first for the identification and investigation only of environmental resources and skills second for environmental problem-solving as well as for problem identification and investigation. This modified classification more clearly illuminates two orientations to environmental education: knowledge and skills for understanding and investigating the environment; and skills and commitment for solving and taking action on environmental problems.

As Table 1 reveals, there was a very close match between curriculum goals related to the knowledge dimension of environmental education (i.e., the development of conceptual understandings about the environment) and the explicit and implicit objectives of all four sets of materials. Two sets, Project Learning Tree (P.L.T.) and "Teaching Activities in Environmental Education," were perfectly and highly matched respectively on objectives concerned with the two categories of attitudes (and values) and skills for environmental investigations. The other two materials embraced only half or less of the curriculum goals in these two categories. A reasonable degree of congruency was evident again in P.L.T. and Teaching Activities in relation to objectives concerned with environmental problem-solving skills, while both Project I.C.E. and "We Can Help" had a low level of congruency. However, no set of materials exhibited a high degree of attention to the participation or action category. Once again Teaching Activities, in particular, and P.L.T. at least gave some recognition to this dimension, while the other two virtually ignored its existence.

In order to gain some insights into the developers' conceptions of knowledge and teaching as they relate to environmental education, a second content analysis was conducted using five criteria from a series of curriculum implications derived by Stevenson (1981) from the objectives and guiding principles for environmental education (as stated in the Tbilisi Conference Report). The questions representing these criteria are intended to gauge whether students: are regarded as active participants in the construction of knowledge; and are involved in making decisions with respect to both their own learning and alternative actions on environmental issues.

The results of this analysis (Table 2) indicate that all sets of materials, except to a lesser extent Project I.C.E., included many activities that involved students in inquiry learning and the use of higher order thinking skills. These activities and projects,

Table 1. CONTENT ANALYSIS OF SELECTED ENVIRONMENTAL EDUCATION MATERIALS (U.S.) USING CURRICULUM GOALS[1] CRITERIA

Goals for Curriculum Development in EE[1]	Predominant Tbilisi Objective[2]	Curriculum Materials			
		Project I.C.E.	Project Learning Tree	"We Can Help"	"Teaching Activities in EE"
Level I: Ecological Foundations					
Subcomponents: A-I	K	X(9/9)	X(9/9)	X(8/9)	X(9/9)
Level II: Conceptual Awareness					
Subcomponent: A	K	X	X		X
B	K	X	X	X	X
C	K	X	o	o	X
D	K		X		X
E	K,A	?	X	X	?
F	A	X	X	o	X
G	A		X		X
Level III: Investigation & Evaluation					
Subcomponent: A	K,S*	X	X	X	X
B	S*	?	X	?	X
C	S		X		X
D	S		?		X
E	A,S	?	X	o	X
F	A,S	?	X	?	X
G	S,P	o	X	o	X
H	A		X		?
Level IV: Action Skills					
Subcomponent: A	S		o	o	o
B	P		o		X
C	P		o		o
D	P				

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[1] developed by Hungerford, Peyton & Wilke (1980): see Appendix 1 for full description

[2] see Appendix 2 for description of these objectives

Key
K - Awareness and Knowledge   S - Skills (*identifying & investigating skills only)
A - Attitudes   P - Participation
o - some limited reference without specific activities to realize this goal
? - not explicit, but could be used for this goal if teacher so desired

Table 2. CONTENT ANALYSIS OF SELECTED ENVIRONMENTAL EDUCATION MATERIALS (U.S.) USING CRITERIA IMPLIED BY TBILISI OBJECTIVES AND GUIDING PRINCIPLES[1]

Curriculum Questions Implied by Tbilisi Objectives and Guiding Principles[1]	Curriculum Materials			
	Project I.C.E.	Project Learning Tree	"We Can Help"	"Teaching Activities in EE"
Do the materials:				
. incorporate inquiry learning methods in critical thinking and problem solving which actively involve students?	occasionally	frequently	very frequently	frequently
. encourage students to select and plan their own activities and projects?	no	occasionally	no	parts of occasional activities
. suggest procedures for examining controversial issues?	no	not directly but implied by some activities	no	no
. suggest ways in which students can work cooperatively with teachers or their local community to investigate environmental problems?	no	no	very frequently	no
. encourage students to become involved in national or international environmental issues?	no	not explicitly but indirectly on occasions	no	occasionally

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[1] **adapted from Stevenson (1981)**

however, did not entail student choice in their selection and planning but offered highly structured approaches to nominated environmental inquiries. Admittedly, it is not easy for curriculum materials to meet this criterion as encouragement of student involvement in curriculum planning is dependent on the teacher. Nevertheless, there are ways in which activities can be made sufficiently open-ended to facilitate such involvement--the American Geological Institute's "Essence" materials provide one example. Only a limited number of activities in Project Learning Tree and parts of a few activities in "Teaching Activities in Environmental Education" met this challenge.

No materials outlined guidelines for teachers to follow in dealing with controversial environmental issues in the classroom or community. Such guidelines may be considered unnecessary as long as suggested activities incorporate, in an inherent structure, methods which provide a balanced treatment of issues. Only Project Learning Tree seemed to offer implicit procedures. "We Can Help" provided many good examples of cooperative investigations in which students could participate, but these were generally restricted to working with refuge managers on wildlife management issues. And only Teaching Activities included a few examples of direct suggestions for student involvement in national and international issues.

To summarize, the majority of materials did not infer the use of a didactic teaching approach, but neither did they advocate a student-directed one. Thus the idea of student autonomy in decision-making on environmental issues and in taking action on those decisions is not an integral part of United States curriculum materials--at least not in the sample analyzed in this study.

Analysis of Australian Materials

While the U.S. materials that have been discussed were produced centrally by curriculum development specialists to guide practice, a major project in Australia, the Environmental Education Project (E.E.P.), was designed to stimulate activity in environmental education by capitalizing on existing "exemplary" practices in schools. The project's "periphery-center-periphery" model involved teachers describing their own "tried and tested" programs or activities, and a central agency editing and publishing the resultant manuscripts and then disseminating the case studies back to schools (Robottom, 1983). Project operation, however, resulted in an alignment again with the research, development and diffusion model since the central sponsoring agency selected the "exemplary" examples, established (as a separate exercise) the project's theoretical view of environmental education, and disseminated "the resultant package of materials...as a set of 'answers'" (Robottom, 1983).

In addition to teachers' descriptive case studies a number of manuscripts were commissioned. These were of two types: theoretical perspectives on environmental education, including an explication--in the form of a conceptual framework--of the philosophy of environmental education; and suggestions for practical activities. The final outcome was the publication of five sets of materials: "A Sourcebook for Primary Education," "A Sourcebook for Secondary Education", two booklets of activities entitled "Streets" (for urban environments) and "Exploring Outdoors" (for natural environments), and a planning simulation exercise called "Walmit Divided."

The project's philosophy of environmental education, which is detailed only in the two sourcebooks, is consistent with the international rhetoric that emerged from Belgrade and Tbilisi. While the E.E.P.'s rhetoric advocated an action orientation to environmental education, a content analysis of the case studies of practice and the three publications of activities revealed a different pattern (Table 3). As the case study descriptions contained insufficient details to apply the 28 curriculum sub-goals of Hungerford, Peyton and Wile as evaluative criteria, the less specific Tbilisi objectives (in the modified category form) were used. Only three case studies and "Walmit Divided" could be regarded as satisfying the participation objective--albeit three of these four in the context of simulated environmental issues. An additional three examples described the development of environmental problem-solving and decision-making skills in their programs. The majority of examples, however, represented an emphasis "on the acquisition of knowledge about the environment through the exercising of process skills in the environment" (Robottom, 1983). Thus in the case of these Australian materials there exists an overt theory-practice gap to which curriculum developers--through their suggestions for practice as well as their selection of exemplary practices--have contributed.

Toward an Explanation of Environmental Education Mission in Action

What explanations can be offered for the general neglect of the action dimension of environmental education in curriculum materials and school programs in both the United States and Australia? Some educators probably would suggest that there is a lack of sufficient guidance for curriculum developers (first) and teachers (second) in the form of instructional objectives and activities respectively (Hungerford, Peyton &

Table 3. CONTENT ANALYSIS OF AUSTRALIAN "ENVIRONMENTAL EDUCATION PROJECT" MATERIALS USING TBILISI OBJECTIVES AS CRITERIA

"Environmental Education Project" Publication	Modified Tbilisi Objectives Category[1]				
	Knowledge	Attitudes	Skills (1)*	Skills (2)**	Participation
Primary Sourcebook: (case studies)					
K-7 Curriculum Design	X	X	X	X	
Environmental Science K-2	X				
Environment Week Festival	X		X		
Drama and the Environment		X	X	X	X
Imagination and the Environment (video)		X		X	X
Pilot Environmental Education Project	X		X		
Primary Environmental Education Project	X		X		
Urban Field Study Centre	X		X		
Curriculum Development in EE	X	X	X		
Activities Using Animals	X				
Secondary Sourcebook: (case studies)					
Humanity and the Environment	X		X		
Environmental Impact Study			X	X	
Studying the Local Urban Environment	X		X		
Interaction with the Local Environment	X		X	X	
Educational Use of an Urban Creek	X	X	X	X	X
Integrated Field Study	X				
Junior Secondary Activities	X	X	X		
Streets	X		X		
Exploring Outdoors	X		X		
Walmit Divided				X	X

*for environmental investigations

**for identifying, investigating and solving environmental problems

[1] See Appendix 2 for description of Tbilisi objectives.

Wilke, 1980). Others would indicate that the problem is a conflict between the conceptions of knowledge, teaching and schooling inherent in an action orientation and those conceptions held by teachers (and curriculum developers) (Robottom, 1983). The first explanation implies that teachers lack the knowledge or expertise to actively engage their students in environmental issues, while the second suggests that teachers either have a philosophical disagreement with the rhetoric (if conscious of their presuppositions) or encounter a pedagogical tension that prevents them from adopting an action orientation (if their presuppositions are subconscious).

Other possible explanations can be found in the literature on citizen action curriculum for secondary schools. In addition to teacher incompetence or unwillingness, Newmann (1975) described two other reservations that are expressed about the feasibility of such curriculum: a lack of student readiness or interest and community resistance. Given, as he stated, that community action projects might place students "in the position of challenging the policies of existing regimes or adult authority, "the question of community resistance and teachers' perception of such resistance is an obvious one.

Therefore, it seems that the following reasons can be hypothesized for teachers' and curriculum developers' reluctance or unwillingness to incorporate an action dimension, consistent with the rhetoric, in their environmental education programs and activities:

(1) an explicit lack of agreement with the rhetoric on philosophical or political grounds;

(2) implicitly-held conceptions of knowledge, teaching and schooling that are incompatible with an action orientation;

(3) a perceived lack of expertise (either real or imagined);

(4) student's lack of maturity, ability or interest to engage in environmental action; and

(5) perceived community resistance (either real or imagined).

Although undoubtedly some teachers disagree with the international rhetoric of environmental education for political reasons, a survey by Childress (1978) found that 75% of teachers rated political justification as being of at least some influence on the rationale for their program or project. This suggests the need to search further afield for a more adequate explanation than political dissonance.

An examination of the piloting of a program involving student participation in citizen action helps issuminate the validly of the other hypotheses. A curriculum model was designed to support Newmann's (1975) rationale and conceptual framework for developing the "ability to exert influence in public affairs through social action" as a central competence of secondary education (Newmann et al., 1977). This model consisted of six main components, one of which was a citizen action project where students work in small groups on trying to influence public policy on a selected social or environmental issue. An evaluation of a pilot program (based on the model) indicated that lack of student interest in action projects was not a problem--provided the issues on which action was taken were ones that are significant to the students involved (Newmann, 1979). On the question of student readiness to develop the skills needed for action project, Kelly (1980) identified three problems that affected two groups in the pilot program--but one group in particular. These were: lack of task concreteness (i.e., specificity, importance, immediacy) particularly, lack of ability to select a project which is both worthwhile and manageable, and lack of commitment. Do these findings support the contention that high school students don't possess the ability and maturity to participate in community advocacy? Kelly was not convinced and implied that the solution to these problems lies in more staff intervention in group work --a need acknowledged by the teachers involved.

This raises the issue of teacher's competence in implementing an action-oriented curriculum. Newmann (pers. comm., 1981) nominated teacher expertise as the single, most significant factor affecting its successful implementation. One of the two teachers involved in the pilot program confirmed the need for teachers to have a background in political advocacy--preferably, but not essentially, in the community in which their school is located (pers. comm., 1981).

Despite being frequently raised by teachers as a likely concern, no evidence of community resistance was encountered in the literature on student action projects. On the contrary, examples were found in both the United States and Australia of environmental action programs that received active community support (Branan & Nathan, 1977; Malcolm, 1981). A convincing argument for why students do not become involved in militant actions that generate negative community reactions has been offered:

> We know of instances in which students acted in ways to provoke community hostility to the programs themselves. This is probably due to the fact that study and discussion among students with differing point of view have

> the effect of ruling out extreme actions. Research also indicates that most high school students believe in conventional political-social philosophy which focuses their attention upon socially acceptable forms of participation. Furthermore, because teachers are very sensitive to possible community reactions, they probably tend to assure themselves of key sources of community support before teaching in such programs. For all of these reasons curriculum efforts in civic participation should not be abandoned because of fears of hostile community reaction. (Newmann, 1979)

Finally, in relation to the pilot citizen action program, it is interesting to note that over the two-year trial period, difficulties were experienced in attracting students. The problem was attributed in part to a view of the program as "inconsistent with the 'real' purpose of school" (Newmann, 1979). The school's administrative, teaching and counselling staff, according to the two pilot teachers, did not believe the program represented worthwhile knowledge and skills.

In summary then, two factors appear to emerge as the real, as distinct from perceived, reasons for discrepancy between the rhetoric and practice in relation to the action dimension of environmental education. Lack of expertise in political action or advocacy among teachers and curriculum developers is the "technical" inhibiting factor. A more fundamental and serious epistemological and pedagogical problem is the dominant conception of : knowledge as objectively constructed; teaching as information dissemination; and schooling as social reproduction. Only the alternative perspective of knowledge as problematic and personal, teaching as the facilitation of critical thinking, and schooling as the fostering of social change, is consistent with the action orientation to environmental education. Environmental education curriculum materials, in their present form and method of development, rather than trying to overcome the obstacles tend to perpetuate them in the way they teach about the environment.

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APPENDIX 1

"Goals for Curriculum Development in EE"*

Level I: Ecological Foundations Level

- A. Individuals and populations
- B. Interactions and interdependence
- C. Environmental influences and limiting factors
- D. Energy flow and materials cycling
- E. Community and ecosystems concepts
- F. Homeostasis
- G. Succession
- H. Man as an ecosystem component
- I. Ecological implications of man's activities and his communities.

Level II: Conceptual Awareness Level - Issues and Values

To Conceptualize:

- A. how man's cultural activities (e.g., religious, economic, political, social, etc.) influence the environment from an ecological perspective.
- B. how individual behaviors impact on the environment from an ecological perspective.
- C. a wide variety of environmental issues and the ecological and cultural implications of these issues.
- D. the viable alternative solutions available for remediating discrete environmental issues and the ecological and cultural implications of these alternative solutions.
- E. the need for environmental issue investigation and evaluation as a prerequisite to sound decision making.

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*Source: Hungerford, H.R., Peyton, R.B. & Wilke, R.J. 1980. Goals for curriculum development in environmental education. Journal of Environmental Education. 11(3): 42-47.

F. the roles played by differing human values in environmental issues and the need for personal values clarification as an integral part of environmental decision making.

G. the need for responsible citizenship action (e.g., persuasion, consumerism, legal action, political action, ecomanagement) in the remediation of environmental issues.

Level III: Investigation and Evaluation Level

To Develop:

A. the knowledge and skills needed to identify and investigate issues (using both primary and secondary sources of information) and to synthesize the data gathered.

B. the ability to analyze environmental issues and the associated value perspectives with respect to their ecological and cultural implications.

C. the ability to identify alternative solutions for discrete issues and the value perspectives associated with these solutions.

D. the ability to autonomously evaluate alternative solutions and associated value perspectives associated with these solutions.

E. the ability to identify and clarify their own value positions related to discrete environmental issues and their associated solutions.

F. the ability to evaluate, clarify, and change their own values positions in light of new information.

To Provide Opportunities to:

G. participate in environmental issue investigation and evaluation.

H. participate in the valuing process in a manner as to permit the receiver to evaluate the extent to which his/her values are consistent with the superordinate goal of achieving and/or maintaining a dynamic equilibrium between quality of life and quality of the environment.

Level IV: Environmental Action Skills Level - Training and Application

To Develop:

A. those skills which will permit them to effectively work toward ends which are consistent with their values and take either individual or group action when appropriate, i.e., persuasion, consumerism, political action, legal action or ecomanagement.

To Provide Opportunities to:

B. make decisions concerning environmental action strategies to be used with respect to particular environmental issues.

C. apply environmental action skills to specific issues, i.e., to take citizen action one one or more issues.

D. evaluate the actions taken with respect to their influence on achieving and/or maintaining a dynamic equilibrium between quality of life and the quality of the environment.

APPENDIX 2

Categories of EE Objectives Recommended by Tbilisi Conference*

a. "Awareness: to help social groups and individuals acquire an awareness of and sensitivity to the total environment and its allied problems.

b. Knowledge: to help social groups and individuals gain a variety of experience in and acquire a basic understanding of environment and its associated problems.

c. Attitudes: to help social groups and individuals acquire a set of values and feelings of concern for the environment, and the motivation for actively participating in environmental improvement and protection.

d. Skills: to help social groups and individuals acquire the skills for identifying and solving environmental problems.

e. Participation: to provide social groups and individuals with an opportunity to be actively involved at all levels in working toward resolution of environmental problems."

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*Source: Toward an Action Plan: A Report on the Tbilisi Intergovernmental Conference on Environmental Education. 1978. Washington D.C.: U.S. Government Printing Office.

SECTION III

CURRICULAR PROPOSALS

EDUCATION IN ACTION: AN ACTION RESEARCH APPROACH TO ENVIRONMENTAL PROBLEM SOLVING

by
Giovanna Di Chiro and William B. Stapp

ABSTRACT: This paper presents the development and implementation of a community environmental problem solving model designed to: integrate the basic disciplines of a school curriculum, improve the learning and instructional goals, and further the quality of the community environment through education. The model is adaptable to both formal and non-formal settings. The model was developed through the collaborative efforts of a cross-cultural team from the United States and Australia. This paper provides a review of some of the history of action research as it has developed in various regions of the world, the methodological process, and the various components of the instructional model, including the aims of the project, roles of the participants, the components of the program, and the implementation of the model. The paper also provides three case studies of the model being implemented and evaluated on an elementary, intermediate, and secondary level in a public school setting. The paper concludes with the identification of pertinent issues in need of further study based on the authors' research, such as the handling of: participant roles, values differences, time constraints, teacher experiences, project scale, and the change component.

Introduction

The following community environmental problem solving model embodies the ideology and methodology of "action research" (AR), a process of both educational research and learner investigation. It is rooted in "praxis", the process of reflection and action, and is a means for teachers to improve their own practice and an aid to students to acquire knowledge and personal empowerment. It is a form of participatory research which involves teachers, students and, occasionally, outside personnel in the process of deliberation on educational practice with the aim of bringing about desired transformations through critical reflection.

As it applies to education, action research has a dual purpose: the improvement of teaching practice and the empowerment of teachers and students and, thus, the quality of education itself. Action research enables the teacher to reflect critically on his/her own teaching practices with the aim of optimizing the educational experience in the classroom. Applied to environmental education, the educational process resulting from AR enables students to participate more fully in the learning process and to assume a greater share of the responsibility for learning, as they engage in a problem-solving process aimed at resolving an environmental issue that they have identified.

This environmental problem solving and action research model is also designed to encourage the integration of the basic disciplines within the curriculum, to reflect upon and improve the learning and instructional goals articulated by the school system, and to improve the quality of the bio-physical and social environment through education. The model has broad application in formal, non-formal and cross-cultural settings; however, this study is directed toward a public school setting at the elementary, intermediate and secondary levels of education.

This paper will, first, outline some of the historical and methodological foundations on which the curriculum model is grounded and the use of action research in the context of environmental education. Second, an account of the development and implementation of the model by the "Michigan Team" will be discussed. Finally, the paper analyzes some prospects for the future--the potentials of the Environmental Education/Action Research marriage and a brief summary of the "works in progress", with which the authors are currently involved.

ACTION RESEARCH IN EDUCATION: A METHODOLOGICAL OVERVIEW

Action research is a form of participatory educational research that aims to understand and solve problems relating to the participant's social and natural environments. Kurt Lewin (1946), widely recognized as the founding father and originator of the phrase "action research", described it as consisting of "analysis, fact-finding and conceptualization about problems; planning of action programs, executing them, and then more fact-finding or evaluation; and then a repetition of this whole circle of activities; indeed a spiral of such circles."

Stephen Kemmis (1982) describes action research as:

> ...a form of self reflective inquiry undertaken, by participants in social (including educational) situations in order to improve the rationality and justice of: a) their own social or educational practices, b) their understanding of these practices, and c) the situations in which the practices are carried out.

Participants at a national Seminar on action research in Australia drafted this definition of (educational) action research in 1981:

> Educational action research is a term used to describe a family of activities in curriculum development, professional development, school improvement programs, and systems planning and policy development. These activities have in common the identification of strategies of planned action which are *implemented*, and then systematically submitted to *observation*, *reflection*, and *change*. Participants in the action being considered are integrally involved in all of these activities" (Carr and Kemmis 1983).

What makes a project action research? Kurt Lewin's legacy surfaces as a common thread in those projects that are called action research. Several important characteristics of contemporary action research are derived from Lewinian theory: its marriage of theory and practice, its method (the action research spiral), its participatory nature, its commitment to democratic principles, and its simultaneous contribution to social science and social change.

A major theme in Lewin's writing was the need to bridge the gap between the concrete and the abstract--the gap between social action and social theory. He felt that action research provided a way both to solve practical problems and to illuminate "general laws of group life," those laws that determine the way certain social behaviors and relationships (eg. racism, elitism, oppression, rich/poor dichotomy) are developed and maintained in social groups (Lewin 1946). According to Lewin, knowledge of these relationships alone is insufficient for the resolution of a social problem. A process of "scientific fact-finding" is essential to supplement this knowledge and leads to the development of the action research spiral of planning, action, reflection and evaluation. This feedback cycle (Figure 1) is the common research method utilized by action researchers (McTaggart *et al*. 1982).

Lewin was committed to demonstrating the superiority of participatory modes of research and group decision-making. Participants should be involved in every aspect of the research process in a collaborative manner (problem identification, research design, action steps, evaluation, dissemination and use). The research process cannot be planned outside the participant group and then "handed over" for implementation and subsequent evaluation by an external agent.

Another essential element of action research is that it is driven by democratic principles. As Lewin stated, action research is based on principles which could lead "gradually to independence, equality, and cooperation " in altering policies of "permanent exploitation" which he saw as "likely to endanger every aspect of democracy" (Kemmis 1982). This aspect of

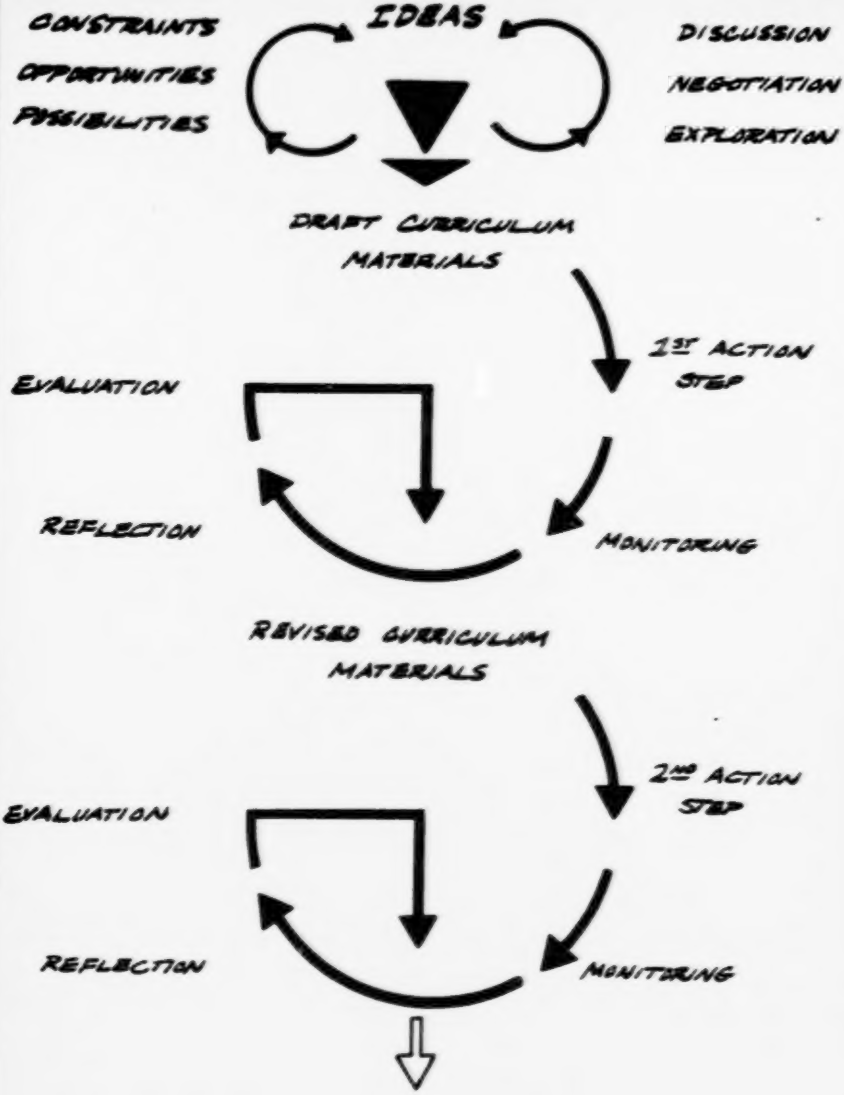
CONSTRAINTS
OPPORTUNITIES
POSSIBILITIES
IDEAS
DISCUSSION
NEGOTIATION
EXPLORATION
DRAFT CURRICULUM MATERIALS
1ST ACTION STEP
EVALUATION
REFLECTION
MONITORING
REVISED CURRICULUM MATERIALS
2ND ACTION STEP
EVALUATION
REFLECTION
MONITORING

FIGURE 1. THE ACTION RESEARCH SPIRAL (ADAPTED FROM McTAGGART *et al.* 1982)

Lewin's characterization of action research echoes Paula Freire's (1973) notion of 'conscienticization." Conscienticization is the process that moves an individual toward human liberation, critical consciousness and, ultimately, to a change in his/her socio-political environment. Through dialogue, humans become aware of their state of oppression and are thus able to "apprehend historical reality as susceptible to transformation" (Freire 1973).

In summary, action research is characterized by several elements:

a) the union of theory and practice
b) participatory/collaborative modes of group process
c) democratic principles
d) the feedback spiral of planning--action--reflection
e) solutions to practical problems that generate scientific knowledge
f) empowerment of individuals and groups to change a socially unjust situation
g) research 'object' that are socially relevant topics to participants.

History of Action Research in Education

Action research has strong historical roots in education. In fact, it was quickly adopted into education almost as soon as German social psychologist Kurt Lewin originated it in the early 1940's (Kemmis 1980). Lewin worked primarily in industrial and workplace settings but also with teachers and teacher educators. The institution that was most central, however, in incorporating Lewin's ideas was the Horace Mann-Lincoln Institute of Teacher's College, Columbia University, under the leadership of Stephen Corey.

By 1949, Corey was the primary advocate of action research in American educational settings. His work was dedicated to the development of research methodologies appropriate for education. The laboratory-controlled procedures adopted from the physical sciences, he says, had led to research "...being rather far removed from the daily activities of the classroom teacher, the supervisor and the school principal" (Corey 1953).

In 1952, Corey spoke of the need for education to prepare citizens for a dramatically changing world. The consequences of modern science and technology on people's ways of living, the world's natural resources, and economic systems, have made it necessary for humans to adjust and make changes in order to survive, and that, he says, is the fundamental role of education. Education must change too, asserted Corey, but the criteria for what should be changed should be developed within the schools and by those individuals who will be directly involved in the changes.

> The studies must be undertaken by those who may have to change the way they do things as a result of the studies. Our schools cannot keep up with the life they are supposed to sustain and improve unless teachers, pupils, supervisors, administrators and school patrons continuously examine what they are doing. Singly and in groups, they must use their imaginations creatively and constructively to identify the practices that must be changed to meet the needs and demands of modern life, courageously try out those practices that give better promise, and methodically and systematically gather evidence to test their worth" (Corey 1953).

A distinct decline of interest in educational action research occurred in the years 1953-1960 (Kemmis 1980). A number of interrelated factors have been suggested to account for this change. There was a growing feeling that research should "retreat back into the academy" and should be separate from the work of practitioners. The rising tide of post-Sputnik curriculum development, based on a research/development/dissemination model of the relationship between research and practice, strengthened and sustained this separation. Moreover, the guiding and fundamental principles of action research had been retrogressively interpreted and reinterpreted, for the benefit of audiences that were trained in the positivistic framework of scientific knowledge generation, until it lost its power as an innovative model of the research process and became a merely a 'version' of more traditional research.

Recently, there has been a resurgence of interest in action research (Peters and Robinson 1984; Kemmis 1980; Smulyan 1983) and an increasing acceptance of action research as a methodology for generating applicable knowledge in the problematic social situation of education (Pine 1981, Smulyan 1983; Carr and Kemmis 1983).

Interest in action research is also growing in other parts of the world including Canada, Australia, Scandanavia, Germany, Great Britain, Latin America, and Africa. In the U.S., centers of interest in educational action research have sprung up within the last ten to fifteen years (e.g., Schwab 1969; Schmuck et al 1975; Ross 1983, 1984; Longstreet 1982; Clegg 1980; and others).

Today, many educators are discussing the value of action research, but as yet, action research is not occurring in may public school classrooms. Ross (1984) offers an analysis based on empirical studies as to the reasons for the lack of implementation of action research in the schools. Some constraints to the establishment of action research model in the schools include; the lofty image of 'research' held by classroom teachers; the large amount of time necessary to collect data, to reflect, to write, and to consult with other professionals; and the often rigid adherence by school administrators and policy-makers to more traditional models of education. Even with the burden of these constraints, several action research projects are underway throughout the country involving, in different combinations, teachers, administrators, students, school staff, parents, and university personnel (Ross 1984, Oja and Pine 1981, Smulyan 1983, Pine 1981).

The re-emergence of action research in the field of education as an alternative method for conducting research to inform practice is evident in the U.S. and in other countries. Its re-entry into the university system offers a base from which it can expand and develop as well as the potential for recognition as a legitimate, rigorous method for the generation of useful knowledge to improve education.

Conditions Necessary for Action Research

A successful action research enterprise requires a working environment that meets a set of necessary conditions. An atmosphere that is supportive of curricular experimentation must be developed and nurtured in every aspect of the educational environment. These conditions fall into different categories: supervisory or administrative, personal style or character of actors involved, organizational structure and climate of school, budgetary constraints, time, and necessary project structure. Clearly, strong interrelationships exist amongst these categories and change in any one condition may effect changes in the others.

Corey (1953) suggests that gaining support from the "status leaders" (e.g., administrators, supervisors) would effect change at all other levels since the educational system is organized as a hierarchy. They must encourage an environment of "trying out" new ideas and experimentation. They can create an organizational structure which is group process-based, thereby facilitating an open, trusting environment in which to discuss and share problems of teaching methodologies, program effectiveness, or personnel issues in the classroom context.

Teacher willingness to be involved in an action research project often depends on a sense of personal efficacy and confidence. There are risks involved in taking on a new methodology in one's profession, especially a methodology that attempts to analyze, critique, and improve the practice of that profession.

In addition, teachers untrained in research techniques and processes may be uncomfortable about participating in such an undertaking. A safe, open atmosphere in which teachers are free to identify problems for inquiry, experiment with solutions and express and share ideas with colleagues and administration is imperative for successful action research to occur.

Time is consistently viewed as a scarce resource in the teaching profession. Action research tends to be highly time consuming because teachers need time during the regular day to think, plan, gather and interpret data, to reflect and evaluate, to investigate alternative research directions and to write.

Administrative support is critical to the success of action research and may take the form of reduced teaching loads, to allow the above activities, or time release for attending professional conference, reading professional literature, visiting classes of other teachers, studying films, texts, nature centers or other educational resources useful to the classroom.

Other necessary conditions for action research include technical assistance and material support such as consulting services, xeroxing, typing, library searches, audio-visual equipment and transportation. Training may be needed in research methods, experimental techniques, use of monitoring equipment or group facilitation methods. In general, however, the action research process is more labor-intensive than capital-intensive and does not require inordinate financial outlays.

THE COMMUNITY ENVIRONMENTAL PROBLEM SOLVING MODEL: DEVELOPMENT AND IMPLEMENTATION

The model was developed by a team of faculty and students from the University of Michigan and Deakin University in Geelong, Australia.

Furthermore, it was clear to the researchers that a community environmental problem solving model, encompassing the methodology of "action research", might be successful in achieving the aim of environmental education as adopted at the Intergovernmental Conference on Environmental Education, convened in Tbilisi, USSR, in 1977:

> Environmental education should be an integral part of the educational process. It should be centered on practical problems and be of an interdisciplinary character. It should aim at building up a sense of values, contribute to the public well being, and concern itself with the survival of the human species. Its forms should reside mainly in the initiative of the learners and their

involvement in action, and guided by both immediate and future subjects of concern (Unesco 1977, 1980).

The researchers then worked to develop a community environmental problem solving model to be implemented and evaluated in school settings in the United States and Australia. The following account will describe only the Michigan-based project (for a detailed account of the Deakin-based project see, Robottom et al. 1985).

The resulting instructional model functioned as two simultaneous "moments" aimed at improving the teaching and learning environment: 1) The Action Research Moment: conducting classroom-based research to develop an improved teaching and learning environment, i.e., developing appropriate curriculum to link more effectively education with real world issues through systematic planning, implementing and evaluating classroom action; 2) The Environmental Problem-Solving Moment: developing a critically aware and responsive population of young people with the motivation and skills necessary to solve problems of important local, social and environmental issues with the aim of enhancing the quality of the socio-ecological environment through educational means. The process was designed for students to gain skills and personal empowerment through participation in the analysis and resolution of a community issue.

An essential component of this model is the development of a "critical community" composed of school administrators, teachers, students, and university personnel (where appropriate). This community of individuals involved in and committed to the processes of education may convene formally or informally to discuss matters of mutual interest concerning classroom activities. The community is critical in that it is involved in conscientious, careful reflection on practices and actions of its members engaged in curriculum deliberations.

Major goals of this project

1) To develop and nurture the understanding that our individual and community actions are connected to human and natural systems worldwide.

2) To promote a cross-cultural direction in education to increase the understanding that we do indeed live and operate in a global society.

3) To improve the learning environment by actively linking education with real world problems and their solutions.

4) To improve the teaching environment by adopting a more critical pedagogy whereby the teacher reflects upon and critiques the curriculum and his/her teaching practices.

5) To enhance learner responsibility and efficacy in taking committed action to improve their own community and environment.

The Role of Participants

1) School Administrators: principally involved in the initial stages of the project to discuss school systems concerns and previously identified problem areas and trends. They also attend an initial planning meeting with teachers and university personnel to discuss goals, roles, processes and the extent of support they are able to offer.

2) Teachers: involved at every stage of the process including: initial planning and negotiation sessions with administrations, designing of the project, implementation, monitoring, and constant evaluation. They should focus on the personal, institutional and political constraints encountered in the classroom in order to work toward their resolution.

3) Students: involved directly in the environmental problem solving process in the classroom. Also involved in reflection on personal feelings and values regarding the learning process they are experiencing. They should consider different aspects that influence this experience including: themselves, the teacher, the school, the administration, the community, the university personnel, parents and significant others.

4) University Personnel: involved in initial planning meetings and through the process if deemed necessary by participants in the projects. Assist in planning, implementation, monitoring and evaluation of classroom activities. Provide suggestions, feedback, curricular materials and other resources in support of the goals and directions of the project.

The Components of the General Process: A Tentative Schedule

There are three primary components to the Community Environmental Problem Solving Model: 1) the preliminary negotiation process; 2) the problem solving process; and 3) the action research process. The following is a tentative schedule for how the model's activities may proceed. It is tentative in the sense that it cannot predict the contextual needs and constraints of particular educational situations. The flow of these components is flexible and should be modified as needed in each classroom context.

The preliminary negotiation process involves University personnel (UP), teachers and administrators in a series of exploratory meetings designed to discuss, clarify and share ideas, goals and purposes of the collaborative efforts. The process may be initiated in a number of ways. In some cases, initial contact with either administrators or teachers may be made by the UP, depending on familiarity with the school system or the individuals. Alternatively, teachers, administrators or other school personnel may seek out an association with UP through connections with the University system.

After the connection is made, the participants meet to discuss goals of the project, to clarify differing and similar values and beliefs on the philosophy of education, and to agree upon the conditions of a "working relationship". Once school administrators have voiced their support and cooperation in the project and understand their role expectations, they assume a less conspicuous role in the process. At that time teachers work closely with the UP to negotiate the principles of procedure of the project. These are mutually agreeable procedural guidelines for conducting the project, gathering the data, and utilization or dissemination of the information and evaluations. The principles of procedure reflect the mutual trust and concerns of the participants and assure protection of privacy and accuracy in reporting accounts of the proceedings of the project.

These meetings concentrate on goals, purposes, roles and in-class procedures. Other issues to discuss are teachers' relationships to students, teacher willingness to be self-reflective, and teachers' interests in dealing with community social and environmental problems. Once understandings between teachers and UP have been established, the students may participate in the negotiation process and the initial planning, if the teacher deems it appropriate. Otherwise, students become integrally involved in the next component of the process--problem solving.

When the teacher and UP enter the classroom, they initiate a joint association with the students and the problem solving process begins. Preliminary group-building discussions with all participants are essential in creating an open trusting environment in the classroom. Some topics of concern may include: explanations for the presence of the UP, some thoughts on how the students feel about their education, discussion of which local social and environmental issues interest students and whether they feel a sense of efficacy in solving those problem issues.

"I think the amount of time was a little much. I think it should have been more organized."

"I really don't think the city officials will respond to a sixth-grade group."

"Didn't know what was expected of us or what our boundaries were."

"It took away from the efficiency of class time."

"We can learn a lot more from the books."

"It took a long time and we only learned about a few things."

"People who need to be directed by teachers do not learn well in this way."

Comments of a 9th grade teacher:

"The setting aside of a block time was unmanageable for both teacher and students."

"Choosing their own topic is not a sufficient motivating force for many students."

"Some students are not mature enough to exercise self-discipline in the use of classroom time for productive purposes."

"Learning is left to chance; there is no mechanism for determining if outcomes were beneficial to the researcher or the group."

It is evident from the foregoing comments that active, participatory, problem-solving education tends to be problematic in the formal education setting. This is a frequent criticism and significant hindrance to the incorporation of environmental education in the public school system. Students and teachers are accustomed to traditional, didactic means of schooling; when activities deviate from that, a substantial amount of dissonance may result. This was exemplified by one junior high student's exclamation: "It was not successful because it was too different, I just plain hated it!" The polarity of evaluative comments was most apparent between the elementary and the junior high experiences. This reflected differences in beliefs, attitudes and values of the two teachers, the diversity of constraints due to time and class load in the two settings and role definitions of participants that existed in the two situations.

We have formulated the following questions that need more examination and consideration prior to and during the implementation of future environmental education and action research projects (EE/AR).

a) Values, Attitudes, Beliefs

1. Should explicit values, attitudes and beliefs of education be shared between teacher and facilitators prior to entering the classroom?

2. Can EE/AR be conducted within the constraints of the formal school atmosphere if the teacher does not value the goals and processes of EE/AR?

b) Time Constraints

1. Can EE/AR be conducted effectively within the secondary school time schedules (50 minute classes)?

2. Do students lose interest if EE/AR is conducted on a daily basis and for 2-3 hours, or would shorter, less frequent sessions be more productive?

3. Can a teacher be expected to have the time to write up accounts of daily practices and changes in a journal, given their full schedules?

c) Knowledge, Skills, Experience of Teacher

1. Would some or all of the following teacher guidelines be beneficial to the teacher in orienting him/her to the procedures of EE/AR: ways to achieve the major goals/objectives of EE/AR; the roles of participants (teacher, learners, facilitators); general classroom processes; data collection techniques; principles of procedures; action research case studies; selecting a community project; handling controversial issues; teacher preparation; program evaluation; etc.

2. Is it feasible to expect a teacher to do EE/AR as a part of his/her teaching practices without assistance?

3. Is it possible for a teacher to effectively evaluate his/her teaching practices alone - or is a critical community of other teachers/ facilitators necessary?

4. Is previous experience in active, participatory and problem solving educational methods a prerequisite for effective EE/AR?

d) Project Scale

1. Are the goals/objectives of EE/AR best achieved by focusing on small-scale projects (school/neighborhood) or large scale projects (state/national)?

2. Are the goals/objectives of EE/AR affected by the size of the working groups and/or what is the optimum size of a working group?

e) Participant Roles

1. Should students be involved in all discussions between facilitators and teacher/administrators in the preliminary EE/AR planning?

2. To what extent is it feasible to have students involved in planning and evaluation throughout the project?

3. Should the facilitators play a passive, semi-passive, or active role during the EE/AR project?

4. Should the facilitators simply reflect on the change process, openly encourage teachers and students to make changes, or take action in the change process in the form of advocacy, influence or resources?

f) The Change Component

1. Did sustained change occurred in teaching practices?

2. Did sustained institutional change occurr?

3. Was the change toward the goals of democratic principles, empowerment and social justice?

4. Did students gain awareness, skills and a sense of efficacy?

5. Were the outside facilitators necessary or influential in the change component?

PROSPECTS FOR THE FUTURE:

The Community Environmental Problem Solving Model raised a number of issues regarding the realization of EE goals in the formal classroom context. Additional investigations and experiences in other classrooms are needed to resolve some of the above issues. Currently, the University of Michigan research team is in the preliminary states of implementing this instructional model with new school districts, teachers, and students, as well as assisting in the negotiations to institutionalize the model in the school system in which it was first conducted.

In regards to institutionalizing the model in the initial school system, the plan is to make certain that the program has the necessary internal support from the local school system prior to initiating efforts in a new school system. It is proposed that the initial school system form a "Community Environmental Problem Solving Curriculum Committee" composed of teachers, school administrators, curriculum coordinators, parents, students and a member of our Michigan research team. Many of the members could be drawn from the six teachers/schools that have been involved in EE/AR. Two teachers from this school system have applied for sabbaticals to receive additional education in the area of community environmental problem solving and would be available to provide leadership to the Curriculum Committee. An important task of the Committee would be to prepare a "Curriculum Guide in Community Environmental Problem Solving." A second major task of the Committee would be the development of a "Community Environmental Problem Solving Workshop" to prepare teachers, librarians, parents, community resource people, administration and others involved in this program. The workshop will be designed to prepare and train new participants in the theory and methodology of community problem solving, classroom guidelines and procedures, and allow them to benefit from the practical experience of teachers who have been engaged in action research. The Curriculum Committee will be responsible for overseeing the development and promotion of the Community Environmental Problem Solving Workshop. Presumably, the workshop would be staffed initially by one or more teachers (from the pool of six teachers trained by our action team) and would make use of the "Curriculum Guide on Community Environmental Problem Solving for Teachers and Administrators" prepared by the Curriculum Committee. The Final component essential to fully integrating this program into the initial school system would be responding in an appropriate manner to the teaching environment and/or institutional constraints which inhibited the full realization of the goals of action research.

Another important step will be to develop, implement and evaluate a community environmental problem solving program for an upper level university course. The purpose of this phase of the project is to treat the methodology of community problem solving at the University level and to train teachers in the "art" of handling this methodology by way of preservice and inservice teacher training. Two University experiences are planned. First, the integration of action research into an upper level "Integrated Resource Management Course" in the School of Natural Resources, University of Michigan, is an effort to enhance learner responsibility and efficacy in taking committed action to improve their own community environment. The course also will be designed to heighten consciousness, facilitate group process and conflict resolution, and to foster critical reflection on information collected and reviewed. Second, an environmental education methods course, cross listed between the School of Natural Resources and the School of Education, will train teacher and youth leaders in the methodology of community problem solving and assist them to improve their teaching environment by adopting a more critical pedagogy whereby the teacher researches and critiques the curriculum and his/her teaching practices. Important goals of the course will include identifying and developing methodologies and curricular materials useful for facilitating community problem solving, promoting the teacher as researcher in his/her professional development and educational innovation, and improving informed participatory decision making.

An ongoing level of activity is to continue our cross-cultural research activities with Australia and Sudan. The co-team at Deakin University, Geelong, Australia, complied substantial data working with multiple schools and is preparing studies similar to this one. A comparative analysis of the similarities and differences of this educational innovation within the two cultures will be prepared. A second cross-cultural network arrangement has been set up in an inter-institutional arrangement between: the School of Natural Resources, the University of Michigan; International Studies Program, Clark University; Institute of Environmental Studies, University of Khartoum, Sudan; and Bakht-Er-Ruda Institute of Education, Bakht-Er-Ruda, Sudan. The purpose of this arrangement is to continue an ongoing arrangement in the development of curricular material on environmental education and to train teachers in environmental education and community environmental problem solving.

Over the long term, the Michigan research team plans to continue to expand its research endeavors associated with the "Community Environmental Problem Solving Model" by working with additional classrooms in various settings (urban, suburban and rural) and in different regions. With new and varied experiences, we plan to continue to adjust and refine the model, based upon thorough evaluation of each program, and to share our findings with people in the environmental education and action research network both through personal exchange of ideas and perspectives in workshops and conference settings and, more finally, through publications in professional journals and conference proceedings.

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INTERNATIONAL ENVIRONMENTAL ISSUES: TEACHING AT THE UNIVERSITY LEVEL

by

Richard J. McNeil

ABSTRACT: Teaching about international environmental issues should be available in the curriculum of every college and university. In many it can be offered as a separate subject.

My course emphasizes 1) vital concepts (such as the global commons, intergenerational trust, scarcity, equity, systems of ownership, systems of cooperation, compatible vs. incompatible world views, cross-boundary movement of resources and pollutants, various meanings of 'development'), 2) facts about international environmental issues and their management (such as Principal organizations, laws, treaties) and 3) values and attitudes, including a sense of urgency with optimism. Concepts are presented through the use of a powerful learning tool, concept mapping, and through the use of case studies demonstrating successes, failures, and ongoing issues (such as US-Canada acid rain, Law of the Sea Treaty, status of Antarctica, export of pesticides, ecodevelopment in Papua New Guinea).

International teaching and program development also require self-improvement, networking, assisting colleagues to grow, and administrative support (both financial and emotional).

Introduction

A course on international environmental issues needs little justification today. A very large proportion of critical issues, including environmental issues, are international in their causes, effects and solutions. This is especially so if we include secondary effects. Also, foreign and international case studies often provide good illustrations of concepts, problems, and solutions which can be applied to domestic situations. The background provided by such a course is useful for many kinds of international and foreign careers and for domestic activities which have foreign aspects. Finally, to be a good citizen today, a deeper understanding of the complexities and interrelatedness of these issues is essential.

ESSENTIALS OF A COURSE

Concepts and concept mapping

I try to teach by making concepts central to my methodology and making facts secondary. Novak and Gowin (1984) present an excellent argument for stressing concepts (which, of course, are abstractions and must be illustrated with facts and case studies).

Novak and Gowin (1984) encourage the use of concept mapping, a technique which I have found very powerful in teaching and learning about international environmental issues. In concept mapping, a group of concepts, related to some central idea and within some context, is selected and concepts are then ranked hierarchically. The concepts are then mapped, usually onto a two-dimensional space, so that their interrelationships are revealed. See Figure 1.

For discussion and listing here, I divide concepts into five clusters: 1) ecological, 2) economic, 3) socio-political, 4) policy formulation, and 5) planning and management. I try very hard, and only partly successfully, to minimize the number of concepts dealt with each day and during the semester. I try to include only those which are fundamental, or critical to understanding behaviors related to the course, of great explanatory power, misunderstood or neglected. Here are mine:

1. ecological concepts

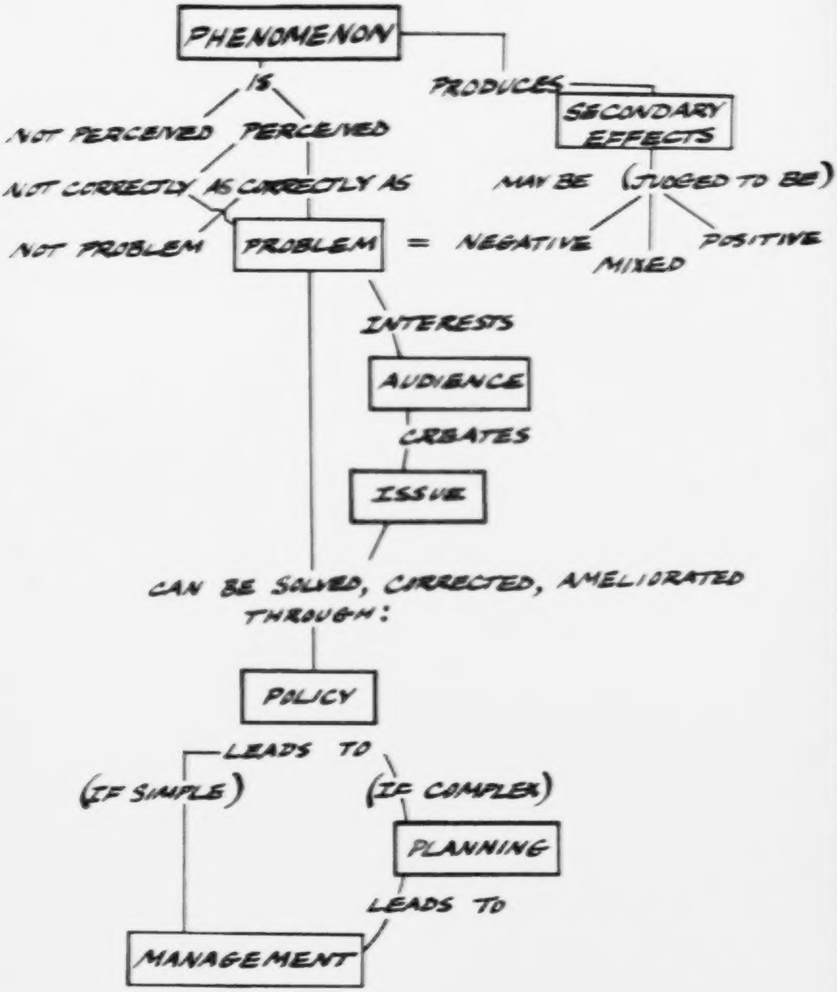
carrying capacity
limiting factors
energy flow
biogeochemical cycles
entropy
information
feedback
stability
interrelatedness
'selfishness'

I assume at least a minimal understanding of most of these concepts but I also test in various ways, including discussion, and I refer students with limited understanding to appropriate texts. Selfishness, as described and meant by Dawkins (1976, 1982) is often a new idea to students, and is valuable in explaining many human conflicts and in initiating our discussions.

2. economic concepts

scarcity
value
resource
cost, opportunity cost
benefit
discounting

In discussing resources, I make a special point of stretching students' definitions to include newly evolving and problematic resources such as satellite orbits, natural processes, and radioband wavelengths.


PHENOMENON
IS
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NOT PROBLEM
PROBLEM
=
NEGATIVE
MIXED
POSITIVE
PRODUCES
SECONDARY EFFECTS
MAY BE
(JUDGED TO BE)
INTERESTS
AUDIENCE
CREATES
ISSUE
CAN BE SOLVED, CORRECTED, AMELIORATED THROUGH:
POLICY
LEADS TO
(IF SIMPLE)
(IF COMPLEX)
PLANNING
LEADS TO
MANAGEMENT

FIGURE 1. SAMPLE CONCEPT MAP

3. socio-political concepts

    ownership
    commons
    development
    progress
    world view
    culture
    altrusim
    responsibility

4. policy formulation

    institution
    power
    boundary
    perception
    risk
    planning
    management
    significance
    phenomenon
    problem
    issue
    policy
    trade-off/
    limited good

5. Each teacher will probably identify a few favorite highly specific, management-related concepts such as:

    compensation
    additionality

Each case study will, of course, bring to the surface several of these concepts within the context of the issue being studied.

Issues, policy and management

A normal sequence of events occurs in resource management. A phenomenon appears and is perceived, a problem defined; if the problem is not solved and it becomes interesting publicly, an issue arises; a policy decision is made; management occurs (modified from Caldwell 1984).

In the story of Chicken Little, a chicken was hit on the head by a falling acorn. She thought the sky was falling, got her friends all over excited, and they decided to go to see the king for further advice. A phenomenon occurred; an acorn fell on Chicken Little's head. The phenomenon may be 'real', 'imagined', or 'metaphysical'. It may be perceived fully or partially, correctly or with distortion. If not perceived, a physical or biological event occurred, but no problem, in the political sense, is present.

The definition of a problem must include some assessment of a negative value. "The sky is falling" (and that is a bad thing to have happen). The problem may be defined correctly or incorrectly, depending partly on the original perceptions. When I was preparing this statement a student said "If you produce a paper describing your course, forty-seven other people will teach it across the continent." The student assigned a negative value to the activity, suggesting that others would steal (or, more gently, borrow from) my work. I saw no problem; I assigned a positive value to broadcasting ideas which I thought were good.

An issue arises when a public becomes interested and involved and the problem still is not solved. In the story, the turkey, the duck, the dog, the goose, all became convinced that the sky was falling. The problem had become an issue.

A decision is made. The animals in the story decided to go and see the king.

Management occurs. They went to see the king. (In the more gory versions of the story, the fox waylaid them and had most of them for dinner.) The cycle of events was completed but another was started. The king perceived a different phenomenon--the report by the animals. And he processed that information and made a new policy decision (he decided to correct the animals' misunderstanding). He shortcut the sequence of events so that no new issues arose. And he managed a previous issue.

Note that in the above sequence:

a) the phenomenon may be a physical event, an idea, a piece of propaganda, and may be thought of as being primary (being hit by an acorn) or secondary (being told that the sky is falling).

b) an issue arises only if policy decision and management are not done (i.e. the time sequence can omit stage 3, the issue).

c) a phenomenon may or may not (correctly or not, partly depending on viewpoint) be regarded as a problem: rain may be a problem to a golfer but not to a farmer; snowfall may be useful to a skier but a nuisance to the man in charge of road maintenance.

d) with questions more complex than that of Chicken Little's acorn, another stage, that of planning, must be interposed between the making of policy decisions and the conduct of management practices.

An understanding of the natural sequence just outlined is fundamental to teaching a course on international environmental issues. It then becomes easy to see that accurate perceptions of phenomena are difficult, that creating an international public interest surrounding a problem is slow and uneven and therefore that issues arise slowly. Discussions of policy-making in an international arena flow easily from case studies of problems and issues.

Policy decisions are, of course, almost always difficult. Besides the questions surrounding such decisions themselves, an international course must examine the extra problems related to the process of decision-making. Case studies of such issues as the

Law of the Sea Treaty and the development debate over Antartica provide outstanding demonstrations of both the difficult policy questions and the difficulties of finding suitable processes for reaching those decisions.

The planning processes and management techniques which follow from policy decisions are interesting, but probably best left to other courses and sometimes other disciplines.

What phenomena are global or international?

If we include secondary effects (such as the flow of refugees after a disastrous flood), most major phenomena are international; some are global. If we look at primary effects only we find few global phenomena. Flood, drought and problems of water quality are regional but not global. There is little to be done on a global scale to manage fresh water resources. Truly global questions include atmospheric CO_2 building up and consequent possibility of climatic change; damage to ozone layer in the stratosphere; policies for use of global commons such as the oceans, Antarctica, and radio wavelengths. Deforestation, (especially in the tropics?) may be a global problem because of the potential for changing the earth's albedo, and hence its climate. Loss of genetic potential and of human cultures is a global issue. All of these named except deforestation represent questions related to management of global commons. Most other international problems are regional or binational, at least in their primary effects.

Which issues are significant? Which are critical?

Caldwell (1984) defines intrinsic significance as the "ultimate importance of an issue for the welfare or survival of human society." He says that political significance (urgency, priority) is seldom determined by intrinsic significance. Too many other political considerations (Caldwell includes "perceived public preferences, the state of economy, military security ... and implications for the personal fortunes of the policymaker") enter into setting priorities. And so, to use domestic examples, snail darters and furbish louseworts get a large measure of attention while hundreds of tropical species dwindle to extinction. We work out methods of artificial resuscitation for sea turtles while erosion carries away millions of tons of topsoil.

Some issues are critical. Immediate action is necessary if a problem is to be averted or alleviated. It may be useful exercise to ask students to create (spontaneously, without reference to outside sources) a ranked list of intrinsically significant and critical international environmental issues. A short discussion will reveal their interrelatedness and will raise students' consciousness regarding significance and criticality. Students' efforts could then be compared with Caldwell's (1984) list or with the Royal Swedish Academy's (Holdgate, Kassas & White 1982) or others available.

Which significant or critical problems are not usually perceived as issues?

It is important for students to understand that some fundamental problems, mostly not 'environmental' in a narrow sense, are not generally seen as issues and yet are basic causative or confounding agents in other problems and issues. These unperceived, fundamental problems tend to be deeper, less susceptible to management, perhaps representing 'the human condition.' My list includes:

- human greed
- misuse and inequitable distribution of power and wealth
- political instability
- lack of political will
- inability or insufficient capacity of socio-political systems to respond
- misunderstandings, insufficiencies in communication systems
- lack of information
- rapid rate of change
- physical scarcities
- positive feedback loops (eg. in most economic systems)
- human population growth

What mechanisms are available for the creation and execution of policy?

It is important for students to understand the kinds of institutions--governments, international quasi-governmental organizations, commissions, private groups (including lobbies and transnational corporations)--that create and execute international environmental policy. Learning about specific institutions is only of secondary value; only the few most prominent and an example of various types should be examined briefly.

I would tend to include the United Nations (UN) and one of its special bodies authorized by the General Assembly, the United Nations Environment Programme (UNEP). Three important specialized groups of the UN, established by treaties, are the Food and Agriculture Organization (FAO), the United Nations Educational, Scientific and Cultural Organization (UNESCO), and the Inter-national Bank for Reconstruction and Development (IBRD or World Bank). Among non-governmental organizations (NGOs) two stand out, the International Union for the Conservation of Nature and Natural Resources (IUCN) and the World Wildlife Fund (WWF). The International Whaling Commission is an example of a geographically broad commission. Regional examples might be drawn from interesting case studies or from the home region of the course, for example the International Joint Commission (IJC: US and Canada) or the International Boundary and Water Commission of the United States and Mexico for students from North America, the South Asia Cooperative Environment Programme (SACEP) for Asian students, or the Organisation pour la mise en valeur due bassin fleuve Senegal (OVSM) for West African students. Also, the tremendous power of multinational corporations can be illustrated by various cases and readings (for example Lappe and Collins 1979).

Similarly, the major types of instruments--laws, treaties, agreements, convention--should be examined but with only a few examples receiving any prominent attention.

I especially favor attention to the Convention on International Trade in Endangered Species (CITES), the Convention Concerning the Protection of the World Cultural and Natural Heritage, and the Law of the Sea Convention.

Many pivotal conferences, statement and programs could also be listed. These might include such examples as the Man and Biosphere Programme, the United Nations Conference on the Human Environment (Stockholm Conference), the World Conservation Strategy, and perhaps others.

I believe that the danger is to include too much of this type of material; it is probably better to limit materials to those which arise naturally during other parts of the course.

A discussion of enforcement of agreements is usually instructive. The power, or lack of power, of the International Court of Justice (World Court) often leaves students feeling helpless until a deeper discussion reveals the power available in public opinion, economic boycotts, international prestige and similar social tools and mechanisms.

Examples include the boycott of Japanese goods by Americans (and others) unhappy with Japanese whaling activities, the social pressure created by disapproval of the use of striped and spotted cat-family furs, the international prestige flowing from the creation of national parks or the name of a World Heritage Site, the power of development agencies such as United States Agency for International Development (USAID), or the embarrassment and social control produced by dramatic actions of NGOs such as Greenpeace.

Values, attitudes and world views

Each of us comes to a teaching assignment with a personal set of attitudes and values. I try to make a few of mine explicit because a) I think they are useful ones and can set an example; b) students can better understand my rationale, objectives, choice of case studies and other ways I influence the course content; and c) discussion of attitudes and values helps to explain differences between cultures and conflicts which arise during attempts to reach policy decision.

Among the values I bring to the discussion are: a sense of obligation, especially but not only to human beings and other living things, present and future; a belief in the need for movement toward sustainability, toward sufficiency, toward equitability. I assume that progress is possible.

The attitudes I find especially useful include optimism, hope, concern, a sense of urgency, acceptance of uncertainty and changes, ability to cope with the realization that some problems have no (short-term) solutions.

I begin and end my course with an extended discussion of the meaning of the word 'development.' I find that students' values and attitudes come forth easily; at the end of the semester students have become much more sophisticated in their understanding.

Each of us sees the world in a different way. Slight differences can usually be accommodated; radical differences may be compatible or incompatible. Even distinctly different views can be accommodated if, for example, laws are accepted as valid arbiters of behavior. Examples of differing world views which typify many resource policy issues include these: sacred cows in India are regarded by some as important both religiously and ecologically and by others as an extreme waste of resources. In Madagascar, aye-ayes and other lemurs are in danger of extinction and many biologists and others value them highly; "some local people are provedly killing aye-ayes in the belief that they are harbingers of death" (Fisher, Simon & Vincent 1969). In Trinidad and Tobago, where national parks have usually served typical 'western purposes' a new park is being proposed for spirits and mythological creatures (Meganck & Ramdial 1984). In Papua New Guinea, Australian advisors attempting to establish a sustained-yield logging operation were surprised to find that the village chiefs had to get agreement not only from current members of their communities, but also from their ancestors, who were the actual owners of the land.

Different world views can affect behavior markedly; resource management decisions are influenced strongly, for example, by fatalistic cultures, those which believe in reincarnation, those which believe in progress, those which believe in the concept of limited good, as compared to cultures which do not hold those values. A culture which believes in cooperation and sharing would conflict considerably with one which believes in conquest, "might makes right", "winner takes all", social Darwinsim. A great many natural resource issues and conflicts arise from and can be explained by these differences in world views.

METHODS

Concept mapping (see earlier section) and use of case studies are central to my teaching methods. Concept mapping organizes my thinking and teaching, assists student learning, and ensures that student and teacher have reached "shared meaning" (Novak & Gowin 1984). Case studies provide concrete illustrations of abstract concepts. Case studies I have found particularly useful include:

ocean policies: The Law of the Sea Convention
management of migratory animals: whales and whaling
status and future of Antarctica
cross-boundary air pollution: US-Canada
internationally shared river systems: management of Colorado River water
export agriculture: Central American bananas
Papua New Guinea ecodevelopment
tropical forests: entire complex of issues, especially Amazon basin
national parks and indigenous cultures: Caribbean region, East Africa
tourism: Mediterranean region
preservation: World Heritage Convention; CITES

With this complex subject matter and a mix of mostly seniors and graduate students I find that a discussion format is essential. For some of the same reasons I require a lengthy (20-30 pages) term paper (See Appendix B) which is analytical, issue-centered, and offers proposals to resolve problems. We also use essay examinations (See Appendix C) and find that most students prefer those which they can take home or, if done in class, which have pre-announced subjects or questions.

We have used extensive readings from a variety of sources (See Appendix A). I have required Caldwell (1984) as a test, and possibly will add Olson (1984) and Lappe and Collins (1978). I believe that an understanding of the recent historical setting of current environmental issues is valuable. Caldwell does that very well, especially in appendices listing international organizations and programs and events of significance for protection of the biosphere.

THE CONTEXT SURROUNDING A COURSE

Courses do not exist in isolation. They are parts of curriculum. More than that, they are immersed in an environment (which they help to create and modify). Libraries, with a small collection of relevant books and a steady flow of relevant journals and daily newspapers, are essential. I have found the following eight journals to be especially valuable: Ambio, Biological Conservation, Ceres, Development Forum, Environmental Conservation, IUCN Bulletin, Mazingira, UNESCO Courier. Films, videotapes and similar aids are useful, especially for setting a scene or mood, for cheap surrogate visits to foreign regions, and for certain examples and case studies. I use one film, A Plague Upon the Land, a 28-minute World Bank film about onchocerciasis, or river blindness, in west Africa. At the beginning of the semester this film leads easily into discussions of obligations, development, equity, role and responsibilities of developed regions and international organizations. Access to such materials is easy; also, visiting scholars from other regions are available in any large community or school. Other faculty members, other students, other courses, and related programs such as semester- or year-abroad courses can greatly strengthen international curriculum efforts.

A curriculum can be part of a program, which may involve research, faculty colleagues, and interaction with related departments. Such a program, in my opinion, needs several elements. These include self-improvement (including travel, extensive reading, contacts with colleagues elsewhere with similar interests), networking (i.e. building up a set of relationships with interested scholars, government officials, members of organizations, foreign students), and administrative support (both financial and emotional) at all levels. An international program works best with at least two faculty members who can complement and support one another's efforts. A final requirement, then, is to assist colleagues to grow, through discussions, literature, seminars, and other means. At Cornell, we have a course which takes 35 students the to American tropics each year to study tropical agriculture and development issues. Each year, one or more inexperienced faculty members travel with the group, gaining international experience and sharing new perspectives with others.

Courses, curricula, and programs are always imperfect but I believe that those targeted toward international perspectives have a special probability of becoming functional, valuable, and pleasurable teaching-learning experiences.

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Novak, J. D. 7 Gowin, D. B., 1984. Learning How to Learn. Cambridge Univ. Press, London.

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APPENDIX A

International Environmental Issues

NR 400 Spring 1985
R. J. McNeil
Course Syllabus and List of Readings

I. Defining Development

Bessis, Sophie, 1982. Recalculating River development costs: The case of Senegal. Ceres, 15(5): 21-26.

Brown, Noel J., 1981. Environment in the 80's: global challenges and responsibilities. Alternatives, 10(1): 7-14.

Eckholm, Erik, 1982. An environment scoreboard. Ceres, 15(2): 15-17.

II. Managing the Commons

A. WHALES AND WHALING

Anonymous, 1982. The cessation of commercial whaling. Oceanus, 25(4): 71-74.

Johnson, Marion Fischel and William F. Gusey, 1982. The Bowhead Whale: life history and issues. Ecolibrium, 13(3).

M'Gonigle, Michael, 1980. The economizing of ecology: why big rare whales still die. Ecology Law Quarterly, 9(1): 119-132.

B. OCEANS: THE LAW OF THE SEA

Borgese, Elizabeth Mann, 1983. The law of the sea. Scientific American, 248(3): 42-49.

Fye, Paul M., 1982. The law of the sea. Oceanus, 13(3): 7-12.

C. ANTARCTICA

Barnes, James N., 1979. Last chance for wild Antarctica? Living Wilderness, 43(145): 32-34.

Barnes, James N., 1980. Danger for the Antarctica. Living Wilderness, 14(150): 15-17.

Mitchell, Barbara, 1980. The politics of Antarctica. *Environment*, 22(1): 12-20, 39-41.

D. THE ATMOSPHERE: ACID RAIN

Howard, Ross and Michael Perly, 1980. *Acid Rain, the North American Forecast*. House of Anasi Press, Toronto, Canada. (Chapt. 10, pp. 81-82). 205 pp.

Wetstone, Gregory and Armin Rosencrantz, 1983. *Acid Rain in Europe and North America*. Environmental Law Institute, Washington, D.C. 244 pp.

III. Resource Allocation, Harvest, and Food Production Issues

A. FRESH WATER ALLOCATION AND MANAGEMENT

Cohen, Maxwell, 1982. River Basin Planning: observations from international and Canada-U.S. experience. *Natural Resources Forum*, 6: 247-261.

Grier, Peter, 1983. Garrison diversion: needed or a clear case of "pork"? *Christian Science Monitor*, May 4: 6.

Holburt, Myron B., 1982. International problems on the Colorado River. *Water Supply and Management*, 6(1, 2): 105-114.

LeMarquand, David G., 1981. International action for international rivers. *Water International*, 6: 147-151.

Kaufman, Michael, 1982. Manitoba lobbying Against U.S. water plan. *The New York Times*, Nov. 7: L-23.

McKinney, Gerry, 1982. Fighting the Garrison Project. *Probe Post*, Jan.: 7-10.

Nguyen, Guoc-Lan, The development of the Senegal River basin: An example of international cooperation. *Natural Resources Forum*, 6: 307-319.

Zaman, Munir, 1983. Legal framework between Bangladesh & India for shared water resources. *International Journal of Water Resources Development*, 1(2): 149-156.

B. EXPORT CROPPING

Burbach, Roger and Patricia Flynn, 1980. Agribusiness in the Americas. (Chapter 10 - Modern Plantation Systems: Del Monte in the Pacific and pp. 105, 128-131). Monthly Review Press: North American Congress on Latin America, New York. 314 pp.

Lappe, Francis Moore, and Joseph Collins, 1977. Food First. (Part III: Colonial Inheritance - Chapters 12 & 13; Part VI: The Trade Trap - Chapters 26, 27, 28, 29). Boston: Houghton-Mifflin Co. 466 pp.

Nelson, Jack, no date. Export cropping and hunger; an interview with Beverly Keene. Clergy and Laity Concerned (CALC) Agrarian Reform Guide: 8-9.

C. TROPICAL FORESTS AND BIOLOGICAL DIVERSITY

Fontaine, Rene, 1981. What is really happening to tropical forests? Ceres, 14(4): 15-19.

Iltis, Hugh, 1983. What will be their fate? Tropical forests. Environment, 24(5): 55-60.

Kandell, Johnathan, 1984. Conquering Bolivia's frontier. New York Times Magazine, Feb. 19: 31-39.

Kennedy, Robert S., 1981. Saving the Philippine Eagle. National Geographic, 159(6): 847-856.

Lovejoy, Thomas, 1982. Hope for a beleaguered paradise. Garden, Jan./Feb.: 32-36.

Lugo, Ariel E., Ralph Schmidt and Sandre Brown. Tropical Forests in the Caribbean. Ambio, 10(6): 325-331.

Myers, Norman, 1981. A farewell to Africa. International Wildlife, May/June: 36-46.

Nations, James D. and Daniel I. Komer, 1982. Indians, Immigrants and Beef Exports: Deforestation in Central America. Cultural Survival Quarterly, 6(2): 8-12.

US Interagency Task Force on Tropical Forests, 1980. The World's Tropical Forests: A Program, Policy, and Strategy for the U.S. (Chapters 4 & 5). Dept. of State Publ. 9117. 53 pp.

IV. Parks and Tourism

A. NATIONAL PARKS

Boza, Mario Andres, 1974. Costa Rica: case study of strategy in the setting up of national parks in a developing country in Second World Conference on National Parks, IUCN, pp. 183-192.

May, Clifford D., 1982. Preservation for profit. The New York Times Magazine, Sept. 12: 50.

Mishra, Hemanta, 1982. Balancing human needs and conservation in Nepal's Royal Chitwan Park. Ambio, 11(5): 246-251.

Sunquist, Fiona, 1984. Cut and burn in a Nepal Park: all in the plan. Smithsonian, April: 165-169.

Western, David, 1982. Amboseli National Park: enlisting landowners to conserve migratory wildlife. Ambio, 11(5): 302-208.

B. TOURISM

Beekhuis, Jeanne V., 1981. Tourism in the Caribbean: impacts on the economic, social and natural environments. Ambio, 10(6): 325-331.

Comte, Marie-Christine, 1980. Managin the Maldives. Ceres, 13(6): 42-46.

OECD, 1980. The Impact of Tourism on the Environment. The Organization of Economic Co-operation and Development, Paris. (pp. 21-41).

V. Development Strategies

A. ECONOMIC ISSUES

Anonymous, 1982. Face up to world tax. Development Forum, 10(2): 1, 4.

Hildyard, Nicholas, 1982. Development - no cure within the market? The Ecologist, 12(1): 2-3.

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Nicholls, Yvonne I., 1973. *Sourcebook: Emergency of Proposals for Recompensing Developing Countries for Maintaining Environmental Quality*. 142 p. IUCN, Morges, Switzerland (Foreword, Chapters 9, 10, 11, 21, 22, 26, 27, 30, 31).

B. ETHICAL ISSUES: HAZARDOUS WASTES

Anonymous, 1980. US checks on hazardous wastes. *Uniterra*, July.

Anonymous, 1982. The return of banned pesticides. *Probe Post*, March: 7-9.

Earthscan, 1980. Dump it in Africa? *UN Development Forum*, November.

Flattau, Edward, 1982. Reagan retreats on aiding environment. *Ithaca Journal*, Ithaca N.Y., 18 February.

Metheson, Alastair, 1980. Pacific fights n-tests and waste dumping. *Uniterra*.

Meacham, Edith, 1983. Reagan throws pesticide boomerange. *Audubon Action*, Oct: 11.

Randal, Judith, 1978. The Production of cancer-causing dyes is being switched to developing nations. *Ithaca Journal*, Ithaca, N.Y. 5 July.

C. TOOLS, ORGANIZATIONS, LITERATURE, TREATIES AND CONVENTIONS, CONFERENCES

IUCN (International Union for the Conservation of Nature and Natural Resources), 1983. *World Conservation Strategy*. IUCN, Gland Switzerland.

D. ALTERNATIVE STRATEGIES FOR DEVELOPMENT

Klee, Gary A., 1980. Traditional wisdom & the modern resource manager. Ch. 11 in *World Systems of Traditional Resource Management*. John Wiley and Sons, NY. 290 pp.

Riddell, Robert, 1981. *Ecodevelopment*. Gower Publ. Co. Ltd., Westmead, England. (Ch. 1, Development in environmental perspective; Ch. 5, Life Support Guidelines; Appendix: Eight Point Development Plan - Government of Papua New Guinea). 218 pp.

Stohr, Walter B. and D. R. Fraswer Taylor, 1983. Development from Above or Below? The Dialectics of Regional Planning in Developing Countries. John Wiley and Sons, New York. (Intro., pp. 39-44, 63-69). 499 pp.

APPENDIX B

Term Paper Assignment
Natural Resources 400 Spring 1985

1. Topic

   Choose an international issue (global, regional, or binational) which has fundamental environmental or natural resources implications. Consult with me by class time on Monday, 25 February about your paper topic. I may be able to help you to get started and/or to avoid unusually difficult topics.

2. Content

   a) Describe the issue you have chosen, its history, present status (including actors involved, reasons for various pressures and interests, the ecological situation).

   b) Describe possible directions in which solutions could go, proposals by various parties, possible tools and mechanisms for resolution (eg. treaties, payments), roles of various institutions (eg. governments, international organizations). Present a balanced perspective, discussing various "sides" or viewpoints and the potential advantages and disadvantages of various possible or proposed solutions.

   c) Present your ideas and opinions, including but very possibly going beyond the mechanisms discussed in this course. Take a position which is unambiguous and defend it as necessary (probably referring also to arguments and data produced in 2b) above).

   d) Support your paper with properly referenced source material and include a list of "Literature Cited" at the end. (You may also wish to include a further bibliography but it is not necessary.)

   e) In general, your paper should be a substantive treatment of policy questions surrounding an environmentally important international issue. Consider the international ramifications of your proposed solutions. Do not overemphasize historical or technical aspects or get too deeply involved in reporting detailed data.

   f) Organization and writing quality count, too.

3. Length

About 20 pages of text (outside limits 15-30 pages), plus literature cited, title page, any appendices or other secondary material you feel you should include.

4. Due date

Monday, April 29, 1985 in class or until 4 pm in 122B Fernow Hall.

APPENDIX C

Natural Resources 400
International Environmental Issues
Final Exam for Takehome Friday May 4, 1984
and return to 122 Fernow no later than Friday
May 18, 1984, 4 pm

Please plan and organize your responses carefully. Limit your reply for each question to one side of one page. Type if possible (single-space OK). Think about fundamental concepts considered in course and add other arguments from background and experience if you wish. You may review the literature and consult with other people but you are expected to turn in work that is clearly the result of your own thinking, planning, organizing, analysis, synthesis.

1. (35%) What mechanisms might be used to increase the chances of financial aid flowing from more-developed to less-developed countries for purposes such as preservation of genetic diversity?

2. (35%) What is an appropriate role (or behavior) for developing, non-industrial nations to take (as they begin to industrialize) with regard to international consequences of pollutants (such as SO_2 which causes acid rain) which they generate?

3. (30%) Name one important international environmental problem that might be susceptible to amelioration by Cornell's Department of Natural Resources. What realistic activities can you propose which the faculty of that department might take to influence the problem you named? (Choose another department of the College of Agriculture and Life Sciences or another college at Cornell for your response if you wish.)

or alternative Q. 3 (30%)

Using examples from the readings and class discussion (and your own ideas), compose a statement on the "ideal" national park philosophy for a developing nation and how it might differ from the U.S. park system philosophy.

SECTION IV

ENVIRONMENTAL PROBLEMS OF INTERNATIONAL SIGNIFICANCE

ACID RAIN: THE SCIENCE AND THE CITIZEN

by
John H. Baldwin

ABSTRACT: This paper briefly summarizes recent scientific findings, most notably by the National Academy of Science, the White House Office of Science and Technology Policy and the Congressional Office of Technology that counter the scientific basis and reasoning behind the Reagan Administrations "research, no action" acid rain policy. Important questions that remain unanswered are identified and discussed. The paper concludes with a discussion of the costs and benefits of policy alternatives.

INTRODUCTION

On October 29, 1981, Kathleen M. Bennett, and Assistant Administrator for the Environmental Protection Agency (EPA) stated in testimony before the U.S. Senate Committee on Environment and Public works:

> Acid deposition is a concern of many Americans, one shared by the Congress, and by the Administration. The depth of our concern about acid deposition should be reflected in public policies that are based on sound science.
>
> As we have indicated, there are major uncertainties in many critical areas, particularly about the transportation and transformation of possible precursor emissions into acid deposition, the effects, and the policy implications of acid deposition. In passing the Acid Precipitation Act of 1980, Congress itself established a comprehensive intergovernmental and interdepartmental research plan so that the complexity of acid precipitation could be more fully addressed.
>
> Without such a firm foundation on which to base our decisions on whether controls are necessary, in what areas, and to what degree, any regulatory action at this time would involve guessing.

Ms. Bennett's testimony represents the official EPA policy of the Reagan Administration toward the acid rain problem. In essence, her testimony contended that sufficient scientific data was not available for the development of a proper control system and that we should wait for more answers before mandating a costly remedial effort. In the intervening four years since that testimony, over 3000 articles, reports, and books have surfaced on the acid rain problem.

The question must be asked, "do we now know enough about acid rain to change the Administrations "research no action" policy?" Or is the issue of scientific uncertainty being used to mask a purely political decision?

Three recent reports have been published in Washington, D.C. that shed some light on the issue of scientific uncertainty and administration policy. These were published by the National Academy of Sciences (NAS, 1983), the White House Office of Science and Technology Policy (OSTP, 1983) and the Congressional Office of Technology Assessment (OTA, 1984). All three reports conclude that the "research no action" policy is not justified on the basis of scientific uncertainty and a control program should be developed based on the current state of scientific knowledge.

Obviously, a gulf exists between acid rain science and Administration policy. To clarify the issues, this paper carefully documents the findings from published referred scientific papers and the forementioned three scientific panel reports challenging the assumptions and contentions behind the "research, no action" policy. These contentions, which most frequently appear in unrefered, in-house reports roughly fall into the following categories (See Curtis, 1980; Dowd, 1982; Poundstone, 1982).

A. Acid rain is not a serious problem in eastern North America.

B. Scientific uncertainty warrants further delay for a more flexible and less expensive control response.

C. Existing controls are sufficient to take care of the problem in the long term.

D. There is no proof of cause and effect of utility emissions and long range acid deposition.

E. The damages reported in Eastern North America are caused by factors other than acid rain such as overfishing, pollution, and land use changes.

F. Acidification of lakes is not a recent phenomenon; lakes have been acidic for thousands of years.

G. The proposed control strategies are not technically feasible or cost effective.

CONTENTIONS AND SCIENTIFIC CONCLUSIONS

Acid rain is not a serious problem in eastern North America.

The following four quotations from the Congressional Office of Technology Assessment and the White House Office of Science and Technology Policy are representative of the findings of the scientific literature:

> About 17,000 lakes and 112,00 miles of streams lie within...sensitive areas. As a "best guess," about half of these lakes and streams have such limited ability to neutralize acid that they will acidify if enough acid-producing pollutants are deposited. We estimate that about 3,000 lakes and 23,000 miles of streams--or about 20 percent of those in the sensitive areas--are now extremely vulnerable to further acid deposition or have already become acidic. New England has the greatest percentage of lakes and streams considered sensitive to acid deposition. The Upper Midwest also has large numbers of sensitive lakes, and many sensitive streams are found in the Central Appalachian region. In addition to the acidification of aquatic ecosystems, transported air pollutants have been linked to harmful effects to terrestrial ecosystems. Broad forested areas subjected to elevated levels of acid deposition, ozone, or both have been marked by declining productivity and dying trees, although it is uncertain how much of this is due to airborne pollutants (OTA, June 1984, p. 16).
>
> The increase of acidity can reach levels which result in the release or 'mobilization' of aluminum from solid minerals raising the possibility of toxic metal effects on biological species in both lakes and forest soils (OSTP, 1983, p. 4).
>
> There is strong evidence for damaging effects on limestone monuments, bridges, and buildings and other structures, but there is no good estimate to economic magnitude of these effects (OSTP, 1983, p.4).
>
> The incompleted present scientific knowledge sometimes prevents the kinds of certainty which scientists would prefer but there are many indicators which, taken collectively, lead us to our finding that the

> phenomena of acid rain deposition are real and constitute a problem for which solutions should be sought (OSTP, 1983, p.1).

Scientific uncertainty warrants further delay for a more flexible and less expensive control response.

Again, direct responses to these contentions are found in the White House OSTP and Congressional OTA response.

> Recommendations based on imperfect data run the risk of being in error; recommendations for inaction pending collection of all the desirable data entails even greater risk of damage (OSTP, 1983, p. 2).
>
> It is in the nature of the acid deposition problem, that actions have to be taken despite incomplete knowledge...If we take the conservative point of view that we must wait until the scientific knowledge is definitive, the accumulated deposition and damaged environment may reach the point of 'irreversibility' (OSTP, 1983, p. 5).
>
> Scientific emissions reductions from existing sources would take at least 6 or 7--and possible 10 or more--years to implement, given the planning, contracting, construction, and other steps that would be necessary. Waiting 4 to 6 years for the results of the federal research program could increase the time required to reduce deposition to 10 to 16 years or more. Because of the time needed for planning, a control program initiated in the near future would not involve major expenditures for at least 5 years. Control legislation could be modified with relatively modest cost penalties until 2 or 3 years before the compliance date, at which point major construction expenditures would have to begin (OTA, June 1984, p.26).

Existing controls are sufficient to take care of the problem the long term.

Through replacement of older high-polluting facilities with new cleaner ones with air pollution controls, sulfur emissions should peak in the first decade of the 21st century (See Figure 1). No further controls, however, mean over two decades of increasing acidic deposition followed by at least three decades of high but diminishing acidifications. The net result would mean high levels of acidic depositions for the next 50 years (Hileman, 1983; OTA, June 1984).

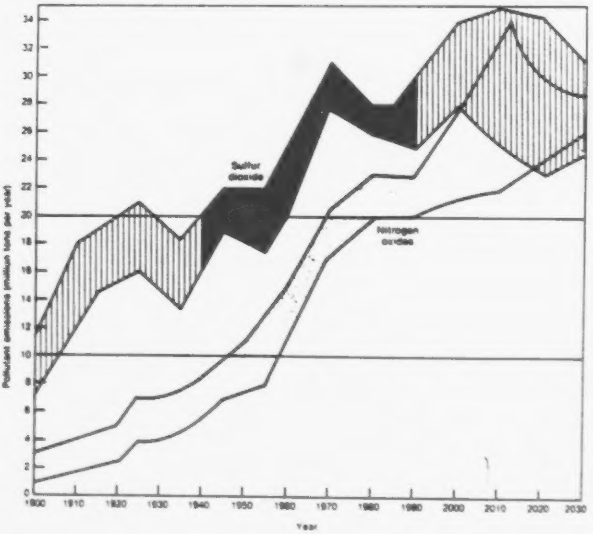

Figure 1. Sulfur Dioxide and Nitrogen Oxide Emissions Trends in the U.S., 1900-2030 (OTA, June 1984, p. 8).

In reference to the issue of delaying action, the Congressional OTA report of June 1984 concludes:

> Any program to reduce emissions significantly would require about 7 to 10 years to implement. If no further action is taken to control emissions, 30 to 40 years will elapse before most existing pollution sources are retired and replaced with facilities more stringently regulated by the Clean Air Act. The effective time frame of most proposals to control acid deposition, therefore, is the intervening period of about 20 to 40 years--long enough to be significant to natural ecosystems (p. 9).

There is no proof of cause and effect of utility emissions and long range acid deposition.

In 1980, 27 million tons of sulfur dioxide and 21 million tons of nitrogen oxides were emitted in the United States. Figure 2 provides a summary of sulfur dioxide and nitrogen oxides by state. The OTSP (1983) report concluded that the areas receiving the highest depositions (the northeastern U.S. and southeastern Canada) are within and downwind from the major source regions (the 31 states adjacent to or east of the Mississippi River). According to the National Academy of Science (1983):

> Analysis of the trajectories of precipitating systems of delivering acidic precipitation to Whiteface Mountain and Ithaca in New York and south central Ontario in Canada indicate that most of the acidity in precipitation at these sites--as well as most of the precipitation--is associated with air masses that have passed over source regions to the south and southwest (p. 140).

Preliminary projections of one of the most sophisticated transport models yet developed indicate that approximately one-third of the sulfur pollutants deposited in the Eastern United States traveled from sources over 300 miles away. Another one-third were from areas 120 to 300 miles away, with the final one-third from sources with 120 miles (Shannon, 1983).

The NAS (1983) and OSTP (1983) reports both conclude that we should not wait for the develop of air quality modeling techniques to track emissions from their origin to their destination before taking strong remedial actions. The following findings are representative:

> An important feature of the long-range transport of air pollutants is that the plumes from individual sources may become so

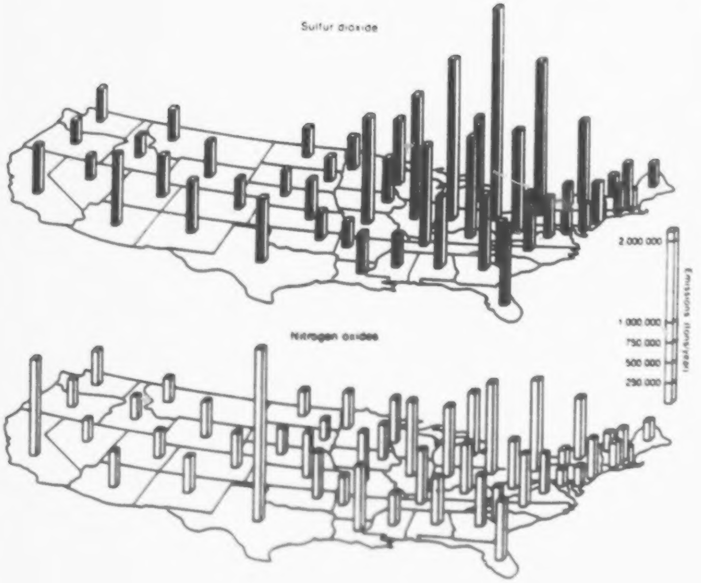
Sulfur dioxide
Nitrogen oxides
2 000 000
1 000 000
750 000
500 000
250 000
Emissions (tons/year)

Figure 2. Sulfur Dioxide and Nitrogen Oxide Emissions by State in 1980 (OTA, June 1984, p. 13).

> dilute and so thoroughly mixed far downwind of major source areas that the attribution of specific particles of polluted air to specific sources is impractical (NAS, 1983, p. 35).
>
> There exists now no acceptable method for the determination of source/receptor relationships on a scale much smaller than 'eastern North America.' With a very large effort in laboratory atmospheric chemistry, in field measurements, and in atmospheric modeling, it might be possible with ten years (but certainly not five years) to produce a source/receptor model for eastern North America. When a verified model exists in the future, there is a possibility that the source/receptor relationship will be sufficiently complex and variable that similar emissions controls would still need to be assigned over large areas rather than locally (OSTP, 1983, p. 3).

A related contention holds that an immediate cutback in the emissions of coal fired power plants will not result in a corresponding reduction in acidic depositions. That is, the relationship between the level of emissions and acidic deposition is non-linear.

> If we assume that all other factors, including meteorology, remain unchanged, the annual average concentration of sulfur in precipitation at a given site should be reduced in proportion to a reduction in NO and sulfate transported to that site from a source or region of sources. If ambient concentrations of NO, nonmethane hydrocarbons, and basic substances (such as ammonia and calcium carbonate) remain unchanged, a reduction in sulfate deposition will result in at least as great a reduction in the deposition of hydrogen (NAS, 1983, p. 7).

The damages reported in Eastern North American are caused by factors other than acid rain such as overfishing, pollution, and land use practices.

In the June 1984 issue of Environmental Science and Technology, Havas, et. al., reported:

> Changes in fish populations appear to be caused primarily by surface water acidification, as a result of atmospheric pollutants, and not by overfishing or fish disease. These conclusions are based on a considerable body of information that includes failure of restocking programs, episodic fish kills, correlations between

> fish populations and pH, characteristic age-class distributions, and distinctive physiological blood parameters. Toxicity data both from field and laboratory studies provide ample evidence that the acidity and the levels of aluminum found in many acidified lakes are severe enough to limit the distributions of fish (p. 183A).

It is true that land use changes can have profound effects on water quality. However, acidification has occurred in many lakes in the past few decades where no land use changes have occurred. Many of the acidified regions are underlain with granite bedrock and poor soils that are shallow, infertile, and poorly suited for grazing, timbering, or agriculture. Further, in regions where land use has changed, no clear relationship with acidification has been established (Gorham, 1982; Havas, et. al., 1984). Again Havas, et. al., (1984) report:

> Although changes in land use cannot be eliminated entirely as a mechanism for surface water acidification, they cannot explain convincingly the widespread regional acidification of lakes and streams in parts of Scandinavia and eastern North America exposed to acid deposition. On a regional scale, the correlation between areas receiving acid rain and those with acid lakes is so strong that land use does not seem to matter (pp. 181A - 182A).

Acidification of lakes is not a recent phenomenon - lakes have been acidic for thousands of years.

There is considerable difference between naturally acidic dystrophic lakes and anthropogenically acidified clear water lakes. Dystrophic lakes or acidic bogs have yellowish brown waters from peat-derived acids and tannins. In contrast, anthropogenically acidified oligotrophic clear lakes have low pH's from inorganic sulfuric and nitric acids and a low level of dissolved organic materials.

The organic material in dystrophic lakes tends to bind metal ions such as aluminum to prevent toxicity to aquatic fauna. As a consequence, dystrophic lakes are not as toxic to aquatic life as anthropogenically acidified clear water lakes.

In addition the flora and fauna of dystrophic lakes have had a long time to adapt to the evolution of the bog. Once the bicarbonate alkalinity in clear water lakes is exhausted from acid deposition, the pH decreases rapidly and decimates the aquatic flora and fauna.

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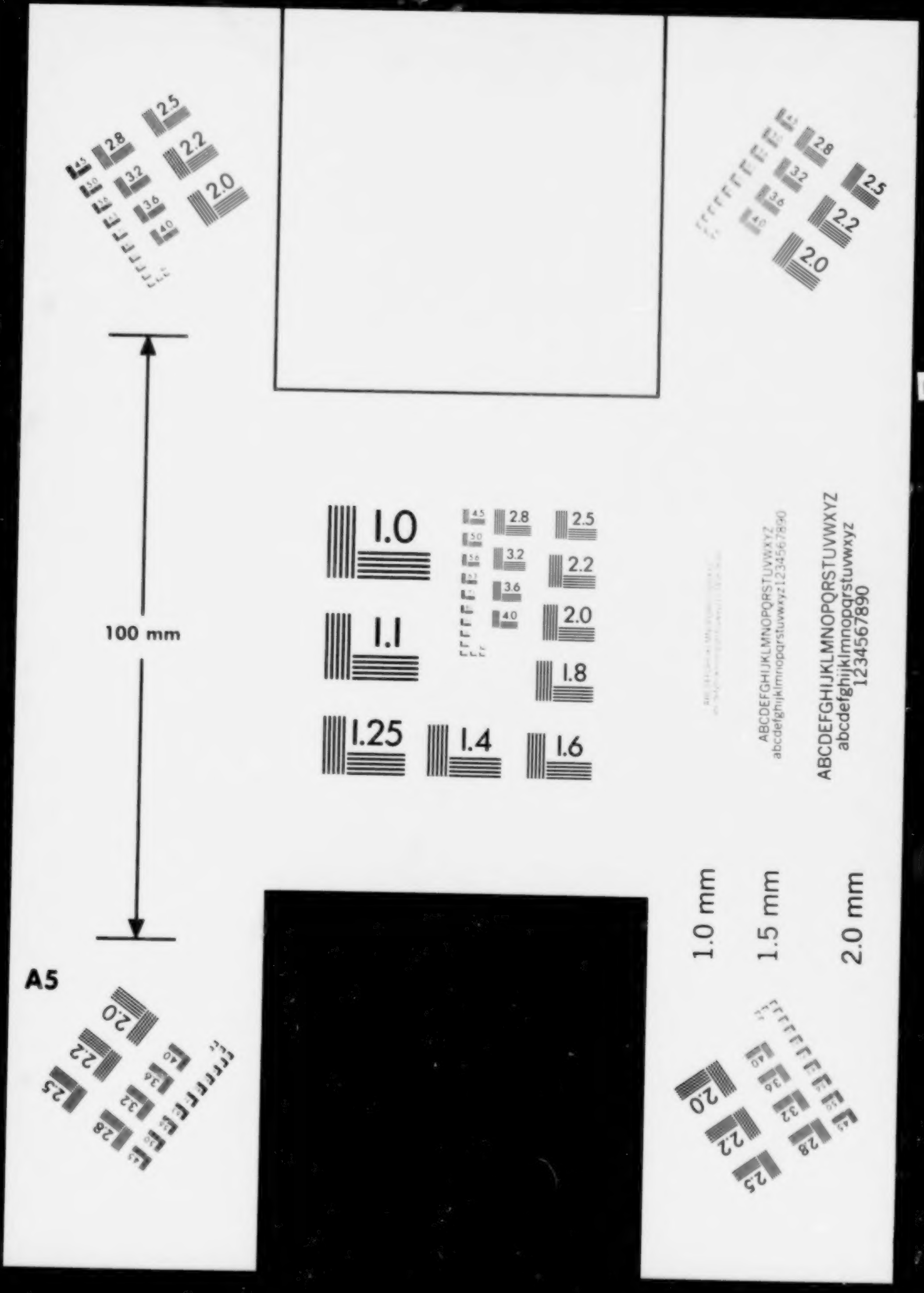

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The OSTP (1983) report concludes:

> Although some kinds of lakes have been acid throughout their known history, others located in principal receptor areas have become appreciably more acid during the past ten or twenty years (p. 2).

The proposed control strategies are not technically feasible or cost effective.

The Tennessee Valley Authority (TVA), the nation's largest consumer of coal, has cut its sulfur oxide emissions in about one-half (from two to one million tons per year). The control program was designed to bring the TVA in compliance with the Clean Air Act. The TVA spent an annualized $334 million for scrubbers, coal washing facilities, and switching to low sulfur cola. The program cost less than $350 per ton of sulfur reduction and raised the rates of electricity from the coal power plants from 6-8 percent (TVA, Sept. 1983).

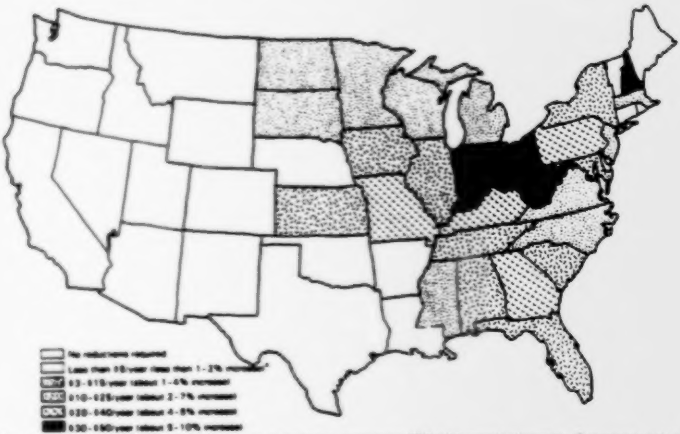
In assessing the costs of a national acid rain cleanup program it is important to consider: 1) the costs of controls, 2) the costs of damages from acid rain to receptor regions, and 3) to whom the costs and benefits accrue.

The most recent independent estimate of control costs was issued in June, 1984 by the Congressional Office of Technology Assessment. Because sulfur has been implicated in many of the adverse effects of acid rain and because sulfur compounds contribute twice as much acidity to precipitation in the Eastern United States than nitrogen compounds, most control strategies focus on a reduction in sulfur dioxide emissions. According to to the OTA (June 1984):

> ...the annual costs to reduce sulfur dioxide emissions in the 31 states bordering and east of the Mississippi River could range from about $1 billion (or less) for about 10 to 20 percent reduction, to about $3 billion to $6 billion for a 35 to 45 percent reduction below 1980 emissions levels by 1995 (p. 21).

The report concludes that this would raise the average electricity rates in the region by two to three percent. As seen in Figure 3, some states would face increase of five to ten percent. In addition, if further reductions are mandated to offset the expected growth in emissions through the year 2000, the increases could reach from 10 to 15 percent.

These cost estimates, however, may be high. If industry and utilities are free to choose their own


No reductions required
Less than $5/year (less than 1-2% increase)a
$3-$15/year (about 1-4% increase)
$10-$25/year (about 2-7% increase)
$20-$40/year (about 4-8% increase)
$30-$50/year (about 5-10% increase)

[a] Average annual cost increase (1982 dollars) for a typical residence consuming 750 kWh/month electricity. Percentage rate increases in each state are calculated from state-average 1982 electricity costs (ranging from about $200 to $900/year. U.S. average about $600/year)

Figure 3. Cost of Reducing Sulfur Oxide Emissions in the United States by 10 Million Tons Per Year to a Typical Residential Electrical Consumer (OTA, June 1974).

methods of reducing emissions, many may choose to wash coal, switch fuels, or burn low sulfur coal. This could reduce overall costs by an estimated 20 percent (or 1.5 billion per year for current proposals--discussed later) (Catalano and Makansi, 1984; OTA, june 1984).

To determine the significance of the costs of controls, the cost of damages from the acidic precipitation should be weighed. The reported damage from acidic precipitation is extensive. According to Ostmann (1982):

> The economic argument for concerted action now to reduce acid-forming emissions in North America is the one most frequently and forcefully presented by those who advocate immediate acid rain remedies. Simply stated, this argument contends that ignoring acid rain will result in more cost to taxpayers than taking action to stop it now. Recent estimates of the damage caused by acid rain in the United States have place the annual cost at $5 billion for the corrosion to buildings, automobiles, artwork, and other human-made objects. The damage to aquatic ecosystems forests, and farmlands has not been estimated, but it, too, could amount to billions of dollars each year (pp. 172-173), (emphasis added).

Without estimates of the damage to ecosystems, forest, or agriculture, it would appear that the costs of damage in dollars, health impacts, and destruction of natural ecosystems clearly outweigh the costs of remedial action. But the problem goes far beyond the simple weighing of costs and benefits. It extends into ethics, proper public policy (in the debate between the U.S. and Canada over acid rain costs and benefits), and international law. Dr. Allen Kneese (1982), Senior Fellow of Resources for the Future, states:

> In this international context, the idea of benefits and costs "to whomsoever they accrue" should be compared for decision making purposes makes little sense when interactions among two sovereign states are occurring. What is involved here, in part at least, is a clash of national interest. It is mostly a dispute about the distribution of costs and gains, not primarily a question of maximizing net gains for both parties taken together.
>
> Resolving this issue is a job more for diplomats, and others responsible for conflict resolution, than for economists. At

best, the latter may be able to generate some needed information for the conflict resolution process.

UNANSWERED QUESTIONS

Perhaps the greatest unanswered question to date in the acid rain debate is the impact of acidic precipitation on crops, forests, and forest soils. The OSTP (1983) report concludes:

> We as a committee are especially concerned about possible deleterious effects of a sustained increase in the acidity of unmanaged soils. Its microorganism population is particularly sensitive to a change in acidity. But it is just this bottom part of the biological cycle that is responsible for the recycling of nitrogen and carbon in the food chain. The proper functioning of the denitrifying microbes is a fundamental requirement upon which the entire biosphere depends. The evidence that increased acidity is perturbing populations of microorganisms is scanty, but the prospect of such an occurrence is grave. It may take years of acidity from wet or dry deposition, before measurable consequences would be observed. Such an effect is 'longterm' or 'irreversible,' It may take at least that many years or longer for the soils to revert to their original condition. It is this possibility which provides us with the greatest concern (p. 4).

Many recent reports (Tomlinson, 1983; Johnson and Siccama, 1983; and Wetstone and Foster, 1983) have evaluated several of the possible mechanisms of forest decline in Europe and North America. Johnson and Siccama (1983) conclude:

> In viewing the spruce dieback and decline as a stress-related syndrome, we suggest the possibility of multiple stresses. Drought followed by infection by secondary organisms appears likely. Conceivably, acid deposition could enhance drought stress or visa versa. The interaction of acid deposition and secondary pathogens is also a possibility that warrants investigation.
>
> The prospects for ecosystem destabilization are difficult to assess in light of available data. To adequately assess the possibility that the high elevation forest ecosystem may be "unraveling" in response to current levels of pollution inputs, more

> information is needed on population dynamics, nutrient cycling rates, nutrient pool sizes and Al biogeochemistry (p. 304A).

Research on the combined effects of ozone and other oxidents in combination with sulfur dioxide and nitrogen oxides on forests and crops has produced some startling results (Grennfeld and Schjoldager, 1984; Skarby and Selldan, 1984). Skarby and Sellden conclude:

> In the U.S. these pollutants are said to be responsible for 90 percent of the crop damage caused by air pollution, amounting to an economic loss of $1-2 billion a year. European studies indicate that ozone plays a central role in damage to crops and forests across wide areas of the continent, the U.K. and Scandinavia. ...reducing emissions of nitrogen oxides and hydrocarbons is the only strategy that will effectively combat the growing menace of oxide pollution.

It is apparent that more research is necessary on the causes and consequences of forest decline in Europe and the Eastern United States. The OSTP (1983) concludes:

> Extensive evidence exists for increasing forest damage in eastern North America during the past few decades. Evidence of acid deposition as the primary cause for such harmful ecological effects on forest and other non-agricultural soils is, at present, much less compelling than that for aquatic damage (p. 2).

If researchers find that this potential damage to forest and field is real, a strong argument could be made for even more stringent and costly controls than those proposed.

POLICY ISSUES

In June of 1984 the Sikorski/Waxman (HR 3400) acid rain control bill was narrowly defeated in subcommittee by one vote--cast by Congressman Dennis Eckart (D. Ohio). The major provisions of the bill can serve as a focus for an overview of acid rain cleanup policy. The bill calls for a 14 million ton reduction of both SO_2 and NO_x by 1993 in all 40 contiguous states. The bill also calls for a reduction of 10 million tons of SO_2 from the level emitted in 1980. The EPA would target the 50 largest emitters of SO_2 by 1990. The remaining three million tons would be eliminated by flexible state management strategies (Catalano and Makansi, 1984).

New source performance standards for NO_x emissions would be tightened to prohibit emissions above 0.3 lb/million BTUs for subbituminous coal and 0.4 lb/million BTUs for bituminous coal. In combination with new emissions controls for trucks, emissions of NO_x would be reduced by four million tons/year (Catalano and Makansi, 1984).

The principal feature of the bill was the establishment of a superfund through the imposition of a one mill per kilowatt hour tax on the consumption of non-nuclear generated electricity in all 48 states. The superfund would be used to reimburse 90 percent of the costs of scrubber installation on the 50 largest emitters.

The low sulfur coal industry and certain utilities oppose the more expensive "technology forcing" characteristics of a superfund. The superfund concept in the bill takes away the utility industries flexibility in controlling acid emissions in the most cost-effective method (including switching fuels, use of low sulfur coal, and coal washing). By mandating scrubbers in the fifty largest emitters, nearly all flexibility to achieve cost effectiveness is lost. The TVA (Sept. 1983), for instance, suggest a least cost approach to emissions reduction which includes:

* Primary emphasis on energy conservation as the least cost method of emissions reduction. (For instance, by 1990, the TVA's conservation programs are estimated to be saving 5.7 billion KWH annually. Reducing capacity requirements by 3000 MW and foregoing an estimated 90,000 tons of sulfur dioxide emissions per year.) (Information in parenthesis added.)

* Required emissions reductions for the 31 acid rain control states should be proportional to each state's share of total SO_2 emissions from all sources for the 1980 base year.

* States should have the flexibility to allocate their emission reduction to any or all sources. Emissions trading and offsets for utility systems and other sources both within and between States should be allowed by the States. In determining a state's compliance in achieving its share of emission reduction, credit should be given to reflect trading between sources in different states. NO_x and SO_2 emission reduction trading should be allowed on a two-for-one basis.

* After the states determine the SO_2 emission reductions that are required from each source, multiple sources such as utility systems should be free to

choose the most cost-effective approach to obtain their allocated reductions regardless of state lines (pp. 13, 14).

However, if total flexibility is allowed and the alternatives to scrubbers are readily adopted, an estimated 20,000 to 30,000 jobs could be lost in the high sulfur coal industry (with an equivalent increase in employment in the low sulfur coal industry) (OTA, June 1984). Thus, by mandating scrubbers on the fifty largest emitters from a superfund levied on all electrical consumers in the lower 48 states, the political liabilities of high costs to the polluting utilities and significant job dislocations are avoided.

Many citizens, scientists, and legislators are, however, concerned about "victims" compensating "villains." As a region, the upper midwest has the poorest record of compliance with existing Clean Air Act regulations. Most other regions have cleaned up and are paying the cost of emissions controls. Even with a 20 to 15 percent increase in utility rates in the upper midwest, the average electricity rates in this region will be substantially lower than those in the Northeastern states (the acid rain receptor region) that burn more expensive (and cleaner) fuels. That, in essence penalizes the responsible and rewards the irresponsible (Dumanoski, 1984). Rhodes (1984) concludes:

> While the superfund idea would assure equity in terms of pursuing a broadly defined public good, it may be difficult for ratepayers in impacted states to accept the notion that Midwest electric rates should continue to be subsidized by acid rain's northeastern victims. Further, it amounts to nothing more than changing the form of the subsidy, from that paid in the form of degraded environmental resources in the Northeast and Canada to a subsidy measurable in dollars and cents.

One partial remedy may be a superfund based on SO_2 and NO_x emissions from all power sources in all states. A tax would be placed on all emissions with a graduated increase in taxes for these emitters not in compliance with existing legislation. Such a tax could be adjusted to achieve the needed level of funding with a more equitable distribution of costs. This could somewhat reduce the preceptions of subsidies and regional inequities--reducing some of the political opposition to the proposals.

However inequitable, it may be politically necessary to superfund acid rain controls. To win the political support of powerful industry and utility interest, particularly in midwestern states, some concessions may be warranted. With these concerns expressed, perhaps new light is shed on the acid rain debate. The question may no longer be a scientific debate over who, what, when, where, why, and how to clean up acid rain, but rather, who pays?

CONCLUSION

The continued use of "scientific uncertainty" as a basis of a policy of "research, no action" is unjustified. Citizens and educators need to be aware of the strong difference of opinion expressed between special interest reports and reports of prestigious scientific panels and the referred scientific literature.

When the most objective and scientifically valid literature is reviewed, little support can be found for the "research, no action" policy. That is not to say that a number of important issues remain unresolved. However, they should not delay or prohibit the initiation of a cleanup program. Therefore, it is important for educators and legislators to focus on the regional, national, and international political and economic issues to ultimately develop an effective remedial response.

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MEDIATING THE UNTHINKABLE: AND EDUCATIONAL STRATEGY FOR ADDRESSING THE PROBLEM OF NUCLEAR ARMS

by

Milton McClaren

ABSTRACT: The problem of nuclear arms and the threat of nuclear war is a major subject of concern of adolescents and adults alike. While typically not seen as an environmental issue, the threat of nuclear war makes efforts at conservation or environmental protection seem futile or misdirected to many people, especially adolescents. Moreover, were a nuclear war to occur it is likely that all life forms in the biosphere would suffer major damage, if not outright extinction. This paper explores ways of examining the question of nuclear arms and the threat of global war by using the topics as opportunities to develop student skills in problem solving and critical thinking. Two approaches are described: the conventional linear Sequential or Stage-based models and a more holistic Process Ecosystem strategy. In the latter, eight processes are seen as forming an ecosystem of understanding in any complex, affect-laden issue. The eight processes are: Knowing, Valuing, Judging, Imagining, Acting, Opening, Inquiring, and Connecting. Examples of questions which students might consider under each process are given and suggestions for establishing a general classroom climate for the discussion/examination of the issue of nuclear arms are given. The author concludes that while there are risks in having public schools examine controversial topics like nuclear war, there are greater risks associated with leaving young people fearful and filled with a sense of powerlessness regarding the issue.

Introduction

The problems of the arms race and the threat of nuclear war are preeminent in our times. They may well be a major influence shaping how young people (and possibly adults as well) behave toward themselves, other people, and the environment. There is certainly evidence to suggest that children think about nuclear war and harbor deep fears for the future (Beardslee & Mack, 1982; Escalona, 1982; Schwebel, 1982; Hargraves, 1984; Yudkin, 1984). It often seems as if persons concerned about environment were addressing an issue which was completely isolated from concerns about the threat of nuclear war. But conservation is a profoundly future oriented activity--an expression of trust in the existence of a future. The possibility of global nuclear war threatens to destroy that trust and, in its absence, make conservation and environmental stewardship seem pointless.

In addition the global pursuit of the arms race may divert precious human and financial resources away from application to the solution of the pressing environmental and social problems of our century (Kidron & Segal, 1981; Peccei, 1982). It is well understood that the consequences of nuclear war would be devastating to human life, but more recent analyses by Carl Sagan and Freeman Dyson give cause to believe that a widespread global war would have a major impact upon the entire biosphere by creating a reduction in the amount of solar radiation received at the earth's surface producing an effect known as "Nuclear Winter" (Revkin, 1985). Nor is the arms race simply an issue of importance to the so-called superpowers or industrialized nations of the First World. The lesser developed countries are now in a position to produce fission weapons and there is evidence to suggest that both India and Pakistan may be working to develop hydrogen bombs, while Israel and South Africa are suspected of possessing such weapons already. As nuclear power plants become more widespread in the developing nations they create a source of weapons-grade fissionable materials which may well be used in the development of nuclear arms. There is even a real risk of such materials being obtained illegally or through piracy by terrorist organizations who may employ nuclear devices as a form of international "blackmail". The theory of "war-by-accident" thus becomes greater and the problems of control and communication are escalated in a major way (Carter, 1985; Kidron & Segal, 1981; Peccei, 1982). The existence of nuclear arms, and the potential for their use presents educators, and environmental educators in particular, with a major challenge.

This challenge is made even more difficult by the fact that the debate over nuclear arms, their deployment, restriction, use or elimination has become intensely polarized and ideology laden at all levels from neighborhood sidewalks and church halls, to legislatures and international assemblies. Somehow educators must make the discussion and consideration of the problem rise above politics; they must make it metapolitical. Opinion about the numbers of humans, or even life forms of any sort, that would survive a nuclear war is divided, but few disagree that any major conflict using these weapons would devastate the very cultures, governments, and technologies that it was intended to defend. Nuclear war represents the death of politics, just as much as the termination of life on an unprecedented scale.

It is the purpose of this paper to explore the educational dimensions of this problem and to suggest some strategies for addressing it which are as free as possible from the limitations of ideology, politics, polemic, and tradition. If the purposes of education are the promotion of critical thinking and the development and examination of a full set of possibilities, then no other human problem is more deserving of an educational approach. However, I think there is another, equally pressing reason for focusing education on the nuclear question. That is, if human intelligence and creativity have produced atomic weapons (and the social and economic systems which employ them) then surely that same intellect and creativity must be used to find ways to restrain or eliminate them. Moreover, young people need to feel that while the problem is grave, it has the possibility of being solved, and that even if we fail, the attempt must be made. Only through this effort can the syndromes of despair and hopelessness in the young be countered.

"It is not for you to finish the work, but neither are you free to desist from it." (from Rabbi Tarfon, Wisdom of the Fathers, as quoted in Wieseltier, L., 1984.)

MODELS OF PROBLEM SOLVING AND THEIR EDUCATIONAL APPLICATIONS IN ADDRESSING THE PROBLEM OF NUCLEAR ARMS.

Before beginning the discussion of problem-solving approaches to consideration of nuclear arms, it is appropriate to note that this strategy is likely of greatest use with students from age thirteen onward (seventh grade). This is not to suggest that the question of nuclear arms and warfare should not be discussed between younger children and caring adults. Most studies have shown that even pre-school children have often heard about "atomic bombs" or about "the world being blown up"; they care about it, have definite opinions, and are often quite fearful. Their fears are not alleviated by the sort of "conspiracy of silence" which is created around the topic by adults in their presence. Young children and adults need to talk about the problem (Van Ornum & Van Ornum, 1984:5).

Young children need to be assured that while the problem is dangerous and fearful (for adults as well) that people are trying to solve it. If parents are involved in discussion groups, protest groups, or are taking personal action at some level, in some form, then children need to be told about this. Silence, fear, and inaction represent a psychologically unhealthy mixture for children (Smith, 1983:389). It may even be very appropriate to invite young children to write about their concerns, in a thoughtful way, to local politicians, but only when the idea comes from the children and does not represent, as has sometimes been the case, the exploitation of the children to advance the political ideas of the teacher. However, the more formal problem solving or process ecosystem approaches outlined below would seem to be more appropriate for older students.

The literature on problem solving is far too extensive to review here (Lochhead & Clement, 1979; Logelin, 1982). There have been a great many efforts to study the processes of problem solving in a systematic fashion in order to discover what people do when faced with different sorts of problem situations. Much of this research has centered around the desire to understand "creative" or "lateral" problem solving, and to try to develop training methods which can help students become more effective problem solvers, or to become more creative. There are a number of difficulties which afflict the problem solving behavior of most people, at least some of the time. People often work with only a few (typically two, very polar) alternatives. They are often strongly influenced by precedent, tradition, and peer pressure. Their own previous experience, with the specific problem, or with problem solving in general, also shapes the way they approach the task. Often people try to go too fast, to get "done", especially when brainstorming ideas. Many people seek simple "rules" or formula where none exist (de Bono, 1976). There is evidence to suggest that attention to how people approach problem situations, and to effective remediation can produce better performance on tasks, while other research indicates that training programs can help with recall, with fluency in the generation of ideas, and with self-discipline, organization, and persistence in the face of obstacles (Lochhead & Clement, 1979). Whether or not creativity can be improved or developed remains contentious, probably awaiting an adequate definition of creativity and imagination.

Training programs in problem solving offer a vehicle for lifting a problem beyond its specific content and context, to provide for a more detached, systematic, and critical review. This fact is of particular importance of the discussion of affect-laden issues like many environmental issues or that of nuclear war. Most approaches to problem solving also provide at least one stage which invites lateral (de Bono, 1979) or creative thinking. If they address the topic of nuclear arms by teaching approaches to problem-solving, schools are given a legitimate opportunity to accomplish two major tasks at once: to address the specifics of an important issue and to develop some major generic skills.

While problem-solving programs differ in title, style, and detail, they tend to have some major elements in common (Renzulli & Callahan, 1976; Logelin, 1982). First, they try to change the "problem" from being a sort of undefined blur of information, a "mess", attempting to clarify and define its elements.

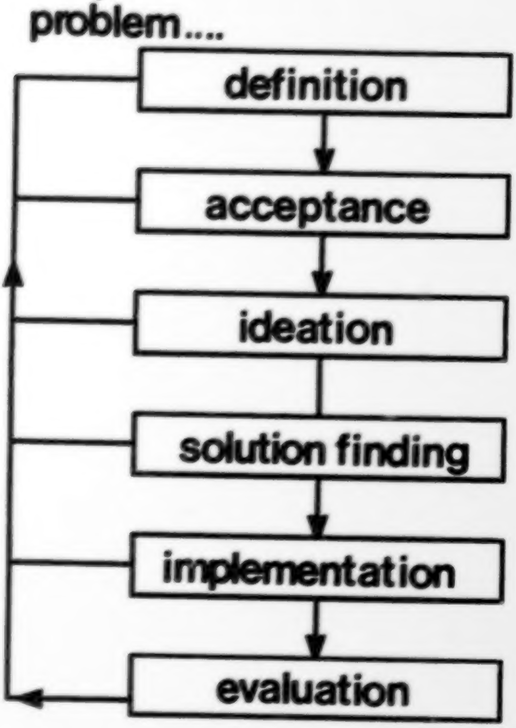
A typical approach is to approach a problem by proceeding in a rather linear fashion through a series of stages. While the terms used by different authors for the stages vary, a typical sequence will include **problem definition, problem acceptance, ideation** (the generation of options or alternatives), **solution finding or accepting**, and finally **implementation** and **evaluation.** Figure 1 summarizes the typical stages in linear models of problem solving in graphic form.

The sheer importance, scope, and complexity of the problem of nuclear arms (and the threat of nuclear war which they represent) may seem to preclude any attempt to approach it in such a linear, even simplistic style. Yet, many of the world's largest and most powerful enterprises (including the armed forces themselves) are operated with management models similar to the above. The operation of many self-regulating or cybernetic systems in robotics, electronics, and biology is similar in style also. (In fact, the developers of these problem solving systems often acknowledge their debt to a study of biological processes.)

Many published "systems" of problem solving (or solution-finding) suffer from limitations. These need to be recognized by teachers before they begin to consider the nuclear arms problem using them. First, they are overly rational, or "cognitive". They forget that people bring feelings and fears, as well as the memory of past failures and successes into problem-solving situations. Thus, the first phase needs to focus on how people feel about the nuclear arms/nuclear war controversy at a personal level. This is especially important, strangely enough, in the context of adult education. Adults, parents especially, have often "dealt" with the question by denying it, or by pushing it under the table (Yudkin, 1984). They do this for fear of frightening children and they usually make the children even more fearful and themselves confused and frightened as well. People also often seem to feel profoundly powerless in the face of the issue, and hence, again, they don't want to discuss the problem because the discussion may well end with them being better informed, but less able to act (Macy, 1983).

A further limitation of the Linear or Sequential models of problem solving is that they often permit people to treat complex issues as if they were value-free and ignore the ethical dimensions of the problem. Furthermore, although it should be possible to "loop-back" to early stages at any step in the process (as shown in Figure 1), people often move through the sequence in a very rapid, goal-oriented way, thereby omitting full consideration of the quality of their information, alternative possibilities, or the consequences of certain actions. Moreover, typical problem solving approaches are essentially offered free of the

Fig.1 Linear/Sequential Problem Solving


problem....
definition
acceptance
ideation
solution finding
implementation
evaluation

"contexts" or environments in which the people who are addressing the problem must operate. It can be argued that during the phases of problem definition or implementation the level of action can be considered, but the problem solving model itself often tends to neglect the various levels at which people may want to act (personal, local, global, etc.). For these reasons the approach which is offered below presents a different model of problem solving and offers a complement or alternative to sequential or linear models.

A PROCESS ECOSYSTEM APPROACH TO DISCUSSING NUCLEAR ARMS AND NUCLEAR WAR

It has often been said that the problem of nuclear arms is not simply one of information, or facts. It is one of values, of judgment, and of action. Many analysts of the relationship between humans and their technology have pointed out that while we tend to emphasize the "tools", they are as much a mirror of ourselves as they are means to ends (Grant, 1976). Even if nuclear arms are never used, they present certain dangers and problems (radiation, local accident, disposal) but these are minor compared to those arising from their use as weapons. The technology influences how it may be used, but it does not, in and of itself determine or require that use. There is a tendency in some curricula which deal with nuclear arms to address only some segments of the problem. As has been mentioned above, some approaches to problem-solving treat problems as if they could be divorced from their value or affective elements. Thus, some approaches have attempted to skirt the political and ideological difficulties in the nuclear question by dealing in great detail with the weapons and their effects. Still others have focused solely upon the issue as political and have linked it to the built-in properties of the communist or capitalist ideologies. To be fully educative a curriculum must address an ecosystem of thinking processes.

Why the term "ecosystem"? Because a natural ecosystem is comprised of a set of elements and the processes by which the elements interact over time. The whole is more than the sum of its parts. In fact, the whole is the product of the interactions among the parts. An educational "ecosystem" involves the thinking processes involved in understanding, in constructing meaning, and in acting. Benjamin Bloom proposed an ecosystem comprised of three domains: cognitive, affective, and psychomotor, while Piaget described the development of the intellectual ecosystem across time, and some of the major processes (assimilation, accommodation) operating in it. In a sense Piaget (1960) and Bloom (1956) have offered us "tools for thinking" (Waddington, 1977) about how humans learn, understand, and construct meaning. I have found it useful, especially for the consideration of how we understand complex, often emotion-rich problems--like the problem of nuclear arms--to develop a descriptive model of the ecosystem of processes which would seem to be involved in the construction of understanding. I have developed this model, or framework, because it helps me to pay attention to a wider set of educational issues than I might do otherwise. The "ecosystem" which I propose is comprised of eight processes. They are: **Knowing**, **Valuing**, **Judging**, **Imagining**, **Opening**, **Acting**, **Connecting**, and **Inquiring**. The eight processes are now briefly described.

KNOWING

Knowing is the process of assessing the kind, quality, and quantity of information which is on hand concerning a given topic, subject, or issue. It involves a review of a learner's personal "bank" of information, and of the processes by which it is updated, reviewed, and restructured.

INQUIRING

Inquiring entails the process of finding existing information and of developing strategies for developing new information. It includes "research", experiment, case study, interview, and observation.

VALUING

The process of valuing is reflected in choices, affirmed positions, and in actions. It entails the assignment of personal priorities in the use of time and energy. Values are evidenced in congruence between verbally expressed views and positions and personal actions.

OPENING

Opening is the process of developing awareness, of paying attention to subjects and objects in a conscious, thoughtful way and of changing or directing the focus of attention. It includes one's self-awareness.

CONNECTING

Connecting entails the process of thinking comprehensively, that is of understanding cause-effect, input-output, and feedback in defined systems.

IMAGINING

Imagining represents the ability to construct and manipulate alternatives at a mental level. It also involves the development and exploration of realities which do not exist in the physical/material realm of experience.

JUDGING

Judging reflects the evaluation of responsibilities and consequences at a personal and social level. It also involves reviewing the social or moral constraints surrounding any decision.

ACTING

Acting involves the process of transforming intentions and goals into actuality at some overt or demonstrable level. It entails formulating strategies and tactics, recognizing and organizing the logistics and resources required, and of making and operating a personal commitment.

Appendix 1 provides some examples of the sorts of questions which students and teachers might address under the eight process headings.

It should be noted that the process ecosystem approach can also be related to different contexts. That is, the choices for action or the strategies of inquiry which one is able to exercise at a personal level may be different from those possible or appropriate at a local-community, regional, or national level. Many discussions of nuclear war or world armaments tend to stay at a large-scale, global level, and entail no real personal commitment. The problem of "Thinking Globally, Acting Locally" has been discussed by environmentalists in particular (Feather, 1980). To assist in considering the different levels at which the several processes might be operated, it is useful to place the processes on one side of a two dimensional matrix, and to place different context levels across the other side. Figure 2 illustrates a possible arrangement.

A two-way table of this type can be a useful device for teachers in planning discussions and in assigning research topics to students. It can also be used by older students as a guide to their own thought and discussion about the topic.

Each of the elements listed above is a Process or is in "motion" psychologically (and perhaps physically). Hence, each is given the "-ing" ending because the English language tends to treat processes as states, creating a sense of things being static, when they are not. Constructing meaning, understanding, and learning are life long functions. But it is all too easy to act as if we had "learning", at least as much as we need, or was possible. To the extent that language shapes thought, we should perhaps pay more attention to our tendency to confuse states with processes, or nouns with verbs (Bohm, 1981). Time is the hidden factor shaping any ecosystem. Thus, it

Fig. 2 Elements of the Process Ecosystem

▼Contexts▼

▫Processes:	personal	local	regional	global
knowing				
inquiring				
valuing				
opening				
connecting				
imagining				
judging				
acting				

TIME ▶▶▶

is important in using this approach to also address time considerations. For example, a decision not to take action of a particular sort is still, in a real sense a decision, and carries possible consequences because of non-action. The quality of information also changes over time, at an increasingly rapid rate in the modern world. Thus, part of inquiring and knowing involves a review of the currency of knowledge, ideas, and information. Hence, in Figure 2 the "time arrow" is a reminder that things change with time and that this hidden factor should be considered.

It should be noted that the Process Ecosystem approach to considering the nuclear issue is not mutually exclusive of the Problem Solving approach; in fact the two are complementary. The process ecosystem approach provides a framework for systematically broadening the way we typically pay attention to many problems.

Whatever models are chosen as a basis for curriculum development and instruction in this, it is important, I contend, that we recognize that the problem of nuclear war is not simply one of gathering "data"--it is multidimensional. It does, however, have a knowledge component and this in itself may frighten parents and teachers from any discussion of the issue on the grounds that they, "don't know enough", or "don't have enough information."

Many programs of problem solving work quite well in dealing with small scale, local problems, but they neglect to deal with the "History is made by other people" syndrome (Kozol, 1975) wherein people simply don't feel that they can possibly contribute anything to the solution of a problem which so many "greater" or "finer" minds have been unable to deal with effectively. It is essential that educators help people to realize that many great ideas in human history have arisen from unexpected and obscure quarters, from people who certainly weren't numbered at first among the "great" or "best" of their times and who often suffered from agonies of self-doubt and failing confidence. Teachers may very well have to call upon "experts" for assistance. But, what is more important is to help people to learn how to find information and to evaluate its qualities. The recent proposals for a space-based defensive system against nuclear weapons offer a good example of an area requiring research and the evaluation of information (Bethe, et.al., 1984).

It is possible to consider the issue of nuclear arms using a general problem-solving framework, while addressing the issue in all its components, as a problem in values and ethics, in knowledge and information, in affect as well as cognition. One issue which is often raised in the context of schools becoming involved in the discussion of nuclear arms is that the teachers are "taking sides" or indoctrinating the students. The "ecosystem" of processes to be addressed which is outlined in Appendix 1 has an "Acting" element in it. Many parents and members of the community are quite willing to have schools or churches discuss nuclear war, but they become most alarmed if action, especially in the form of protests or challenges to authority are advocated. I do not feel that it is responsible for schools to encourage people to think about problems, without also helping them to consider what they, personally might choose to do. It should be emphasized that this is entirely different from teachers advocating particular courses of action. Teachers can help students address the Acting component by having them generate and consider possible courses of action, and by then considering the possible consequences of those action, for them, for their families, or friends. It is not the role of educational institutions to urge a particular course of action, or even to urge action per se, but it is the role of education to help people think about action versus inaction, and about options and consequences critically. By consigning the question of action to the Null Curriculum (Eisner, 1979) schools commit de facto indoctrination to inaction, or to positions which don't permit even the discussion of possible actions.

TEACHING CONSIDERATIONS

The general problem-solving approaches described above will function best in a classroom environment which has certain general characteristics. First, it is important for teachers to establish a tone which is very open to ideas of all sorts. This means that not only does the teacher respect and consider carefully the ideas of students, but also that the students respect each other's ideas. Often adolescents are very intolerant of unorthodox or unpopular points of view when they are expressed by their peers. A teacher who wishes to embark on consideration of a complex and affect-laden issue such as nuclear arms or war needs to discuss with a given class the tone which will be appropriate and the general rules of conduct vis a vis ideas. Second, it is important that the teacher hone their own questioning strategies so that they can use question which clarify, extend, call for reflection, or which apply empathic or active listening. By being able to use effective questioning techniques the teacher presents a model for student interactions as well. Third, it is vitally important that the teacher attempt to help students recognize the differences between opinion, fact, value statement, speculation, invective, and ideology. One way of doing this is to teach students a system of coding which they can apply to written examples such as editorials drawn from local or national newspapers or magazines, whatever the topic of the editorial. As students gain practice in this they begin to become much more active listeners and readers while also developing their capacity to think clearly and critically about issues. The teacher should then employ the same coding system in their review of student written or oral presentations so that the students recognize their own use of opinion, fact, evidence, value statements, or invective. Finally, before beginning a unit of teaching in which a topic such as Nuclear War is to be considered, any teacher is wise to make the students very clear that what will be done is to examine the issue critically from ALL sides without advocacy. Otherwise, often through casual student comments at home, parents may gain the impression that the teacher is indoctrinating students. Ideally, teacher-parent communication and consultation should occur in advance so that miscommunication will not occur.

CONCLUSION

Goodlad (Goodlad, 1984) has pointed out that the traditional coalition of educative forces: the home, the school, and the church, has recently been joined by a new member, the mass media, television in particular. Debate regarding the impact of TV on contemporary values, attitudes, life styles, and actions continues. However, there can be little doubt that this agency plays a role as an instructive or informational force; as such, it influences the other traditional members. Television has demonstrated its capacity to present graphic images of the horrors of nuclear war (even if they are still far short of the likely reality). The media bombard young people with opinions, information, ideologies, value statements, and images, but they have yet to demonstrate a highly serious commitment to helping people think critically about the problems of our times, albeit that they may provide food for such thought.

Schools are likely poor competitors with the modern mass media in the sheer transmission of information, images, and ideas. They are, especially in partnership with the family, the most appropriate agencies to develop the critical thinking abilities of young people. Few issues in our time have greater need for effective, clear, critical, and creative thought than the problem of nuclear war. The schools can play a central role in this, but only if they can somehow manage to raise their approach to the problem above ideology and advocacy and can demonstrate their power in education as opposed to indoctrination. The road will not be easy. The modern scene is crowded with critics of schools who want them to narrow education to information transfer or to restrict the curriculum so as to guarantee successful indoctrination of the young by others. The challenge is great, but so are the risks.

Many people are concerned that the young may be left both powerless and without hope as they contemplate the threat of nuclear war. From an environmental perspective we are unlikely to engage people in the effort of environmental conservation, protection, or management if they believe that this will be futile given the probability of a nuclear holocaust. In my view, the only way this terrible apathy can be avoided is by creating an educational climate in which the nuclear issue is given priority and in which young people and adults alike are helped to think out the problem and to define and choose thoughtful courses of action. For schools to attempt this will throw questions about the purposes of education into sharp focus, and will invite immediate attack from those who fear education. But over what better issue, and at what better time, should this debate be joined?

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APPENDIX 1:

QUESTIONS FOR EXPLORATION IN EACH PROCESS 1

APPENDIX 1:
POSSIBLE QUESTIONS FOR EXPLORATION BY STUDENTS AND TEACHERS UNDER EACH PROCESS IN THE PROCESS ECOSYSTEM

KNOWING

Write down some of the main facts which you think you know now concerning nuclear arms. How up to date is this information? How reliable were the sources from which you obtained it? How often have you read articles in serious magazines, or editorials in major newspapers on the topic? How much of your knowledge comes from the television? Do you think you have enough information, too little, or perhaps too much? Repeat this sort of process for your information regarding a nuclear war. Make a list of "items" divided into the following categories: things you think are firmly factual; opinions supported by reputable evidence; opinions not supported by evidence; speculations. About which areas of the issue would you like to know more; about which would you like to improve the quality of your present information?

INQUIRING

With your present knowledge and information about nuclear war and arms in mind, how could you go about improving your current information position. For example, what are the major current sources of information about nuclear arms, arms control, and the risks of nuclear war? Have you ever investigated the political stance of different news media? Do you know how various lobby groups get the funding for their campaigns, whether pro or con on the nuclear arms issue? Are there any first hand sources of ideas and information in your community--for example, local military base commanders or representatives from companies with major defense contracts? Have you ever invited these people to speak to classes or to citizens groups? Are there simulation games which represent various options in global conflict? Have you played any of these? Do they provide a good representation of current problems?

VALUING

What is your personal position regarding war? How is this position reflected in your daily life and actions?

Do you think that war is never justified, sometimes justified, or frequently justified? How do you support your view(s)? Do you think that violence solves human problems? What do you think about non-violent resistance? What sorts of approaches to conflict resolution do you employ in your own affairs? What are your views regarding democracy, capitalism, free-enterprise, and communism? How do these change your behavior or shape your daily life? Do you have any idea about major sources of your ideas: parents, teachers, friends, the media, great historical figures? Do you feel that you have the right and capacity to choose your own positions about views which you hold strongly? If you were a parent, what would be your stance concerning violence on television, war toys, or other representations of war or violence in the lives of your children? How would you act on this position?

OPENING

What are your feelings about the possibility of nuclear war? Are you optimistic, or pessimistic? do you feel that you can have some influence in the question, or that you are powerless? Do you feel that you've thought the issue through, informed yourself, and made a thoughtful set of choices about it? How are you influenced by your peers, by family, or by past experiences? Are you simply so fearful of the topic that you don't know what to do, and don't want to discuss it or think about it?

CONNECTING

What are some of the consequences of the arms race on your daily life? Is anything made more costly? Are there products that you can't purchase as a consequence of the arms race? Is the Quality of your life increased or decreased? For example, are you prepared to make long term plans for a career, for education, for marriage? If you are not, is this a consequence of deep feelings of uncertainty about the future? Who stands to benefit from a continued major national expenditure for arms? Who stands to lose? Are some things being done because of the arms race, while other things are not being done, because of the same set of priorities?

IMAGINING

What would the world be like without the actuality and threat of war, of all kinds? Can you visualize a peaceful world? What kind of governments would exist?

What sorts of human activity would thrive? Can you visualize the world after a nuclear war--what sorts of images come to mind? Can you imagine a set of events which could happen to transform the world from one of war to one of peace? How would humans be different in a peaceful world? How would people have to become different in order to attain a peaceful world?

JUDGING

What are the personal consequences of your present situation regarding the question of nuclear war? What are the consequences of your action/inaction? Are you happier, more confident, do you have a better self-image? Have you considered various alternative positions to the one you now hold? What would happen if you selected a different course of action/position? How would your family or friends feel or act toward you? How would you feel about yourself? Are your actions and opinions in conformity with your values or beliefs? Why not? Are you acting as you are because of what you feel to be your "duty" or responsibility as a "citizen", or as a member of a particular social or ethnic group?

ACTING

In your opinion, is any action, personal action, required on this issue? If it is, what steps can you take to accomplish this action? What obstacles exist to block you? If you don't act, will there be consequences? If you do act, what consequences will result? Can you devise a strategy for overcoming your obstacles? Can you make a "time line" or a schedule for your actions? Are your actions consistent with your knowledge, feelings, values? Have you any means of evaluating your actions and of modifying them on the basis of this information?

CONTRIBUTORS

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